Information exchange through mobile phones and its conversion to capital resources: experience from Bangladesh rice farmers

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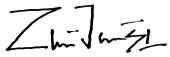
Signed:  Date: 23/08/2017

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And finally, arriving at this point of my life would not have been possible if not directed by the One from whom originates all aid, to whom be all praises.

Our creation is the modification of relationship

~ Rabindranath Tagore

Abstract

This thesis centres on the way in which networks, capital and resources are created among small-scale rice farmers in Bangladesh through communication using mobile phones. It is evident from previous research that the use of mobile phones has rapidly diffused in developing countries such as Bangladesh. Emphasis in this work is placed on the primary use of mobile phones as a voice-to-voice communication tool and the process through which communication and information exchange translates into various forms of capital and resources for the rice producers. The building of social and commercial networks by the rice producers through their mobile telephony requires an understanding of the their social and commercial interactions, institutional influences, and choice dimensions.

A theoretical framework is introduced based on interrelated perspectives by integrating structuration theory with the social network, institutional influences and choice of the farmers. In the framework, the integration of these theories indicates that the rice producers create a provisioning state. This provisioning eventually transforms the communication to different forms of capital and resources. Methodologically, a survey of a representative sample of the rice producers was carried out, and case studies data was obtained. The statistical data has been utilized for descriptive statistics on selected indicators. The case studies on the selected farmers incorporate the mobile usage data to explain the usage patterns of the rice producers.

The findings show that in accordance with the proposed framework, the adoption and use of the mobile phones is influenced by various agency factors such as age, education and gender. The results also show the impact of choice on importance, relevance and use of mobile phone for the rice producers. The use of a mobile phone is also influenced by interrelated factors such as institutional practices and the nature of the rice farmers' commercial network. The findings show that despite the similar socio-economic conditions, the rice producers create different levels of capital and resources due to differences in their socio-technical provisioning. This research provides relevant theoretical foundations and a framework that contributes to a better understanding of how mobile phone usage impacts the gaining of knowledge, capital and resources, through enhancing commercial and social connectivity for the rice producers of Bangladesh

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1. Introduction

This research explores and analyses the use of mobile phones as a part of Information and Communication Technology (ICT), and their role in the commercial efforts of rice producing farmers in rural Bangladesh. ICT is a broad academic area. In this study the context of mobile phone use by the rice farmers has been chosen as the principal focus, and the information exchange facilitation is subsequently examined. The rice producer's commercial networks (e.g. buyers and suppliers) are different from that of other types of farmers. Their commercial needs and communication timespans also vary from that of other farmers. Therefore, the commercial network that the rice producers create and that of other farmers, is a separate discussion within the domain of agricultural academia. In order to understand the role of the mobile phone as a tool for information exchange, the communication process is also discussed. ICT research explores these information transfer processes with varying perspectives and emphasis, depending on the availability and prevalence of communication media (e.g. radio, television, mobile phones). Furthermore, the motivation and objectives of ICT research is reflected by the communication metrics chosen by researchers.

This research places emphasis on the use of mobile phones for both commercial and non-commercial use by rice producing farmers in Bangladesh. There has been substantial research (that is elaborated upon in the literature review) relating the impact of mobile communication to the commercial outcomes of rice growers, with varying viewpoints exploring the interlinked and interdependent dynamics of agriculture, trade, and knowledge creation. This study gives specific emphasis to the social influences dictating mobile phone usage along with the communication processes that create and facilitate the exchange of commercial information and the generation of capital.

1.1 Background

Bangladesh is a developing country situated in South Asia. It has a population of 163 million people (DESA, 2015), making it the eighth most populous country in the world. The country formed as an independent nation after separating from Pakistan following a liberation war in 1971. Most of the country comprises of fertile deltaic land formed by sediment flowing from the Himalayas over millennia. As a result, the landmass is largely flat, abundant in rivers and wetland, with an elevation very close to sea-level. The waters from the Himalayas flow through India and Nepal, carrying with them alluvium; a sediment highly rich in nutrients that aids vegetation growth. Along with a sub-equatorial climate and plentiful rain, the land is well suited to farming and agriculture. Naturally, its people evolved into what is largely an agrarian society, to this day.

66% of Bangladeshi people reside in rural areas (World Bank, 2016). The majority of these rural inhabitants directly or indirectly depend on agriculture or related activities as a source of income, with farming, forestry, and fisheries occupying 60% of the total labour force (CIA, 2016). These occupations are highly vulnerable to natural calamities such as floods, cyclones, droughts, etc. which occur every year affecting innumerable rural livelihoods in Bangladesh. Nonetheless, despite the almost annual certainty of natural disasters such as flooding, the farmers continue to reside close to the floodplains, simply because with the rising water comes replenished soils, and the prospect of high yields.

Rice is the primary staple food of the country, with a total of 80% of the total cultivated land being used for its production. There are a number of reasons for the specific dependency on rice, asides from general traditional habit. Rice is a relatively easy crop to grow, given the fertile geology. Manual labour makes up for much of the country's employment, and rice is a filling food, with more than 70% of the population

obtaining their daily caloric requirements through this grain. With the onset of modern medication and vaccinations, Bangladesh experienced rapid population growth in the 20th century (BBS, 2016), and the role of rice in the nation's food security only became more crucial. Being a less economically developed country, with a large part of the population (31.5%) living in poverty (World Bank, 2016), the consequences of dependence on this grain has historically been fatal in the years with drought. Research by Vázquez & Sumner (2013) found Bangladesh to fall within a cluster of nations with high poverty and malnutrition, along with very high dependency on agriculture and low labour productivity. Whilst global aid and advances in agriculture have helped to improve the country's self-sufficiency, the importance of rice has not diminished, and the grain continues to play a role of economic significance. From a government policy perspective, structural transformation in Bangladesh is limited in terms of the ability to shift emphasis from agriculture based systems, to entrepreneurial or manufacturing focused ones. Despite this, according to the (World Bank, 2013), poverty has declined at a rate of 1.8% between 2005 to 2010, with the number of people living in poverty falling from 63 million in 2000, to 47 million in 2010. The economic significance of rice production is linked with relatively low rice prices, and this has a beneficial influence on the poor. Rice production has successfully provided food security and employment in Bangladesh. Therefore, for further economic growth, advancing farming technology is the practical way forward as opposed to an industrial paradigm shift.

Despite being a predominantly agricultural economy, development is occurring in Bangladesh. The country's GDP increased from $53 billion to $173 billion, between year 2000 to 2014 (World Bank, 2016). This development has an effect on the livelihood strategies for the rice producers, particularly in Asia, where the labour engaged in rice production ranges between fifteen people per day per hector to two hundred people per hector per day; a significant proportion for a single crop. The

lower rice price due to large-scale production is beneficial to the poor, but creates a disincentive for the rice producers. However, the challenges for the farmers arise from their socio-economic, technical and existing institutional practices. The major challenges in the agricultural sector of Bangladesh include high-population growth, climate change, imbalanced fertilizer usage, inefficient water usage, pests & diseases, lack of quality seeds, inadequate credit support, and a general lack of research (Mondal, 2010). Most of these challenges are linked with the knowledge and communication strategies of the rice farmers. For example, lack of knowledge affects the use of fertilizers, as found by (Ruttan, 2002), in which the use of fertilizers for high yield is proven to be failing in the long-term due to eutrophication of ecosystems. Similarly, inefficient irrigation methods lead to suboptimal use of water, the remediation of which is dependent on the farmers gaining knowledge on water reservoirs, land levelling, etc. (FAO, 2011). Similar research conducted on 187 farmers in Uttar Pradesh, India shows that only 40% accessed information on farming techniques (Mittal, et al., 2010).The research also shows the challenges of acquiring reliable, consistent information regarding agriculture. Consequently, farmers rely largely on traditional knowledge and their own beliefs for decision-making. Knowledge is invariably dependent on communication, something which has become easier through mobile phone for the rice farmers in recent times.

The last decades of the 20th century and the early 2000's have marked a period of rapid economic growth in Bangladesh, through access to foreign markets, trade exports and other benefits of globalization. Around the same time, mobile phones started to appear in the country. Initially a luxury tool for the affluent, within the span of a decade they have become a device that is available to people from all walks of life, and the rate of expansion of their use is highly contrasting to that of wired telecommunication in the country. Bangladesh has had a long history of limited telecommunication services available to its masses for a long time following its

inception. Government data from 2003 indicates a telephone density of 0.63 per 100 people, which was the lowest among developing countries. The total number of landline phones in the same year was approximately 920,000 (Bhuiyan, 2004), of which 83% was connected to urban areas. Furthermore, for most of the population who lives in the rural parts of the country, only 17% had access to landline phones during that time (Alam et al. 2010). According to data from Bangladesh Telecom Companies Limited (BTCL, 2016), mobile communication was first introduced to the nation in 1994 through the private organization Grameen Phone, with the purpose of developing a village based pay phone service that may benefit agricultural entrepreneurs (Lucini & Hatt, 2014). With the company's success in providing telecom services in remote parts of the country, the Bangladesh government sanctioned further telecom operators to accelerate the outreach of mobile phones in the following years. Subsequent rapid privatization of the telecommunications sector provided a deeper penetration of mobile infrastructure in the previously unreachable zones. According to the BTCL data, in 2014 there were a total of 114 million mobile phone subscribers in Bangladesh, the vast majority of which are rural inhabitants. This widespread use of mobile phones has enabled reaching the people in rural areas of Bangladesh who were previously disconnected, and had limited access to knowledge and information beyond a certain radius. As highlighted by George, et al. (2011), ICT, especially mobile phones, have extended the communication and co-ordination possibilities between different stakeholders in agriculture. It became possible to reach a vast number of rural inhabitants particularly from an agricultural background, to be able to communicate and provide knowledge.

According to Lucini & Hatt (2014), access to mobile phones has the potential to resolve two commercial problems for the farmers:

1. Lack of information on agricultural inputs
2. Access to market by avoiding intermediaries

The research by Lucini & Hatt (2014) indicates that there exists a possibility to expand the mobile outreach further by attracting 14 million farmers in Bangladesh under mobile use coverage. Furthermore, there are still 22 million farmers who own mobile phones but do not use any agricultural services provided by the operators. Therefore, it is unknown what the communication priorities are for this vast majority of the farmers in Bangladesh who use mobile phones without using any specialized agricultural services. Research by (Islam & Grönlund, 2011) on a total of 1,680 farmers of Bangladesh used TAM (Technology Acceptance Model) to investigate the farmers' motive for acquiring mobile phones. TAM is conducted by learning about the motives that dictate the farmers to buy the mobile phone. Based on the research, 75% of the farmers bought mobile phones influenced by their family, friends, and relatives. The research also shows a direct influence of age, education and perceived usefulness of mobile phones, and the external influences such as market factors. This perceived usefulness by the farmers also indicates the importance of communication among farmers.

Research conducted by (Lokanathan & Kapugama, 2012) in subcontinent countries on 505 smallholders and 447 agricultural SMEs, shows that in Bangladesh 66% of farmers' decisions are taken under peer influence. According to the author, the farmers acquire knowledge from the following sources:

- Self-knowledge
- Other farmers
- Family and friends
- Traders, collectors and buyers
- Input suppliers
- Mass media
- Specialized services from private businesses
- Government agricultural extension agents

The rice producers through their communications with these contacts create networks, and these networks are the source of the commercial information that they receive. Typically, mobile phones serve to develop many small networks consisting of farmers

in varying numbers rather than by forming a big network that connects many farmers. For example, an individual with a mobile phone may create their own network with a small number of contacts (small network), compared to a radio station that creates a wider network. However, this does not mean a mobile phone is limited in increasing its networking range, and there is no exact physical boundary limiting the mobile-led network from evolving into a wider network. For the rural rice producers, the network may vary in size, depending on factors that influence the nature of their mobile phone usage.

Frias-Martinez & Virseda (2013) analysed the impact of mobile-led networking on human activity, and in particular on social interaction. The research project was data intensive, and the social scientists involved were interested in gaining insights into individuals' habits, attitudes, and routines, which are indicative of the highly varying nature of networks. This is also valid for rice producers in Bangladesh; despite the strong impact of networks on the rice producers' decision making being evident, there is no specific research in academia on *the nature* of mobile phone use and *their network*. Frias-Martinez & Virseda (2013) also shows that mobile users were influenced by different variables, and the research highlighted how the actors' individual and social profiles influence the elements of interest to form networks. The previous discussion highlighted the commercial contacts of the farmers and the importance of networks in the creation of knowledge for the rice producers. The information that is acquired by using mobile phones has a vital influence on the commercial efforts of the rice producers. An understanding of the way this network creation occurs and how the information translates to knowledge and action for the rice producers is therefore important.

1.2 Motivation

According to the World Bank Report (2013), the increase in global food prices resulted in 40 million people falling into poverty over a span of one year. Rising global population is expected to further exacerbate this crisis in the near future. To feed the world's population, food production needs to increase by 70% by next decade (FAO, 2009). Muthayya, et al., (2014) show statistics on global rice production and consumption, according to which rice makes up the staple diet of 3.5 billion people worldwide, largely in Asia, Africa and Latin America. There is also an estimated 870 million people suffering from malnourishment associated with global food poverty. Furthermore, rising populations in less economically developed countries (90% rise between 1996 and 2000) do little to alleviate the crisis. Bangladesh is a prime example of one such nation with high birth rates. These challenges stress the importance of the agricultural sector in ensuring global food security. According to Miller et al. (2013) the use of mobile phones by farmers is important to gain better access to the market, obtain information/advice from distant contacts/experts, and gather information as needed in order to make informed decisions. This impact is also linked with achieving a better price for the producers and knowledge on inputs, essential aspects in determining the profitability and livelihood cultivated through their trade. There are distinct examples of person to person services provided by the mobile phone operators, such as banking services that benefit people from various professional backgrounds. An example being M-PESA in Kenya, which led to a number of success stories for developing countries. M-PESA enables rural Kenyan residents to transfer money without physically going to any bank. Agricultural sector findings from the aforementioned by George, et al. (2011) indicate that the mobile based service Market Light provides SMS based information on 150 crops and 1000 markets, and collectively benefitted farmers by generating 2-3 billion dollars in income (Mehra, 2010).

From a theoretical perspective, the way in which information impacts human agents is within the broader context of rural society and information systems research. It is important to stress that in this research, the impact of technology on farmers is not a discussion on technology or rice production, or of business impacts such as changes in profitability. It is a study of *the nature* of the technology use, and is therefore a discussion on a social phenomenon.

Although this work emphasizes value creation for the rice producers, this value creation is not perceived with emphasis on any particular mobile based services such as those discussed earlier, and the target group of this research is primarily the rice farmers of Bangladesh. Although there are examples of services existing exclusively for the farmers, and positively correlate with their financial well-being, this research rather looks at the benefit gained through the primary use of mobile phones as a communication device and how the communication exchange translates to any form of an asset or capital creation. This value created by the farmer is linked with their socio-economic aspects as it is linked to the rice farmers' decision to use the mobile phones in a certain manner that translates actions to their benefit and wellbeing. As elaborated earlier, mobile phones are capable of providing specialized services such as M-PESA or Market Light. However, the capital generation through market specific services is far exceeded by the overall global capital generation through mobile communication facilitated agricultural trade, and the benefit is associated with the *nature* of mobile phone usage, rather than available application based services. Especially because of mobile phone availability in the rural areas where systematic disadvantages prevail through gender and economic disparity, and mobile phones facilitate social inclusion (Waema & Miroro, 2014). The ubiquitous nature of mobile phones, and their affordability in developing nations makes insights into the *nature* of their usage a prominent area in developmental research.

The benefit is reflected in literature, directly linking mobile communication with increased farm-level productivity, greater access to the value chain and better public service delivery (George, et al., 2011). The actual benefit, value and commercial gains for the rice producers can therefore be determined by focusing on their process of sending and receiving information through mobile phones. This research also questions the nature and limitations of the benefits created by using mobile phone.

In the context of Bangladesh where rice is the principal crop of the nation, the value creation through widespread agricultural mobile communication is of great significance, and provides a valuable comparative insight on how phones impact different crop value chains.

The principal motivation for this study originates from three broad interlinked discussions:

1. International agencies and their expectations from the widespread use of mobile phones in developing countries.
2. The theoretical basis for understanding the IS (information system) phenomenon in developing countries.
3. The core motivation and communication of the rice farmers' decision making process.

1.3 Research Problem and Questions

The research problem addresses the nature of the rice producers' mobile phone usage, and the resulting outcome. Specifically, there are several interrelated theoretical discussions. The rice producers are not only commercial agents in society, but also residents in their rural areas who are influenced by the local culture and practices. The rice producers therefore need to be considered from an individual's perspective with regards to the social and commercial environment. This perspective covers two

dimensions that are linked to the research objective; the individual factors and the commercial context of the rice farmers as entrepreneurs. As this research focuses on the mobile phone as a communication tool, the network created by the rice producers as a result of their profession is a prime discussion, and not the network they have by any other means. The understanding of the broader development outcome of mobile phone use, therefore, is possible by acknowledging the complex social dynamics of the rice producer. As the research problems develop, they will discuss how the generation of assets or capital is associated with mobile phone use for the rice producers of Bangladesh. Before the problem statement is explained, it is important to elaborate on background discussions relevant to the problem.

The research problem has its origin in two distinct discussions.

- The importance of rice producers' in Bangladesh, as a provider of the principal source of daily nutrition, along with the implications this has for national food security.

- The growing expectation from information communication technology, in the context of the nation's technological development.

According to the World Bank (Qiang, et al., 2004), information and communication technology by definition incorporates hardware, software, network and media that collectively transmit, store and present information in various forms of voice, text and data. Information influences the decision-making process for individuals. This is directly linked to social networking achieved through mobile communications, and enables the development of social capital that supports the individual in their professions. This social network can be defined as a person or node who is linked to a network that provides information flow through friends, family or commercial contacts. Furthermore, in order to understand the impact of mobile communication

on the rice producers, it is necessary to understand the actual process of information exchange, and who (or where), the rice producers acquire their knowledge from. It is also of interest to understand why the nature of mobile phone usage varies between different types of farmers, despite the commonality in profession, and any influence that formal education, gender or economic background may have. This discussion ultimately integrates relevant theories and an empirical understanding of mobile phone usage of the rice farmers. As noted, the aim of the research is not to assess the outcome in purely financial terms or measure the efficiency of mobile phones for commercial use. The research is rather focused on the nature of use that enables the rice producers to achieve commercial, social and other resources or capital as intended.

The core research questions incorporate the factors affecting the use of mobile phone from an individual level. The work also questions the actual process of information exchange and how different forms of resource or capital creation is made possible through mobile communication. Based on the background and problem statements, the core research questions are –

1. How do the individual and surrounding factors influence the rice producers' mobile-led network creation?
2. What is the actual process of information exchange through which rice producers create different forms of capital and resources?
3. How are these various types of capital and resources generated and configured for the rice producers?

The first question centers on individual attributes such as age, education, and gender, along with institutional and traditional influences. The second question examines the process that brings the individual rice producer into a network that facilitates information exchange. This requires explaining the social, commercial contacts and the individual rice producer's communication preferences. The third research question

discusses how the information communication creates knowledge and translates the knowledge creation to various types of capital and resources.

1.4 Significance

This research is conducted on the rice producers of Bangladesh who represent the majority of the country's population that is dependent on rice for their livelihoods. Their commercial wellbeing is also linked with the national economy and the nutritional wellbeing of the country. Rice is of principal agricultural and dietary significance, as it is the cheapest food source available to eradicate any acute malnutrition. According to Bishwajit, et al., (2013) Bangladesh is the sixth rice producer of the world with 75% of its cultivable land being utilized for rice production. The research makes a comparison of rice production between the south-east Asian countries, according to which Bangladesh produced a record of 34.25 million metric tonnes of rice in 2011 constituting for 92% annual good grain production. The resulting GDP contributed to 30% to the national economy. The importance of rice production, therefore, lies in its economic contribution, nutrition, employment and food security of the country. Research conducted by Ahmed (2004) describes rice as a political crop in Bangladesh, as the government regularly stockpiles large volumes in order to manage food scarcity and price volatility. The author also explains how rice production symbolizes food self-sufficiency and is considered to be a national pride. As a result, the government provides fertilizer subsidies to facilitate production. Furthermore, the research indicates that although unlikely, there is a possibility of deficit in rice production in Bangladesh, and if this occurs, the country will face food shortages, with consequential implications on poverty.

According to the George, et al. (2011), precision agriculture refers to an information and communication technology based agricultural system, whereby farmers make decisions based on site-specific technologies, GPS, wireless sensor networks, improved

seeds, crops and harvesting machinery. The future possibilities of rice production in developing nations is linked to this concept, and the use and exchange of information is crucial in facilitating the development of precision agriculture. This type of technology and infrastructure requires both capital investment and government support, and more importantly an efficient network that is inclusive of the key actionable individuals – the rice farmers. The farmers' current use of mobile phones and their way of receiving and transmitting field information to government bodies or other relevant contacts is indicative of their readiness to grow and adapt, consciously or unconsciously to transition into technology based farming.

The information and communication literature discusses the benefits of using mobile phones in the context of developing countries. Research shows that there is an advantage of using the mobile phone on adding value to GDP (Lucini & Hatt, 2014) and to the creation of jobs. Recent research by Dey, et al. (2016) on Bangladesh rice producers' value creation shows that the impact of the mobile phones is not only occupational but also social. The study conducted on 50 rice producers from two locations indicate that the nature of mobile phone use by the rice producers is dependent on the infrastructure, social and institutional practices. The research shows that the networks with the social contacts benefitted the rice producers who live in an active social environment, and observed a commonality in mobile phone usage among the rural working people class between India, Bangladesh, and parts of Africa. Although there has been substantial work establishing the benefit gained through the integration of technology such as mobile phones into agriculture, an area of lesser exploration is the specific pathways of value creation, along with the social influences that shape them.

According to Heeks (2010), there is a little contribution to development studies as a disciplinary base for ICT research. As an example, Heeks (2010) mentions that among

the 211 authors who presented in 2009 ICTD conference, there was only one originating from a non-information science background. Furthermore, the lack of input and perspectives from business and management backgrounds in ICT was also highlighted. This research is designed to contribute to the debate from an alternative perspective.

Reflecting on both of these studies by Dey (2016) and Heeks (2010), it is important to conduct research that considers the multiple dimensions that affects the use of mobile phones, such as in this case the rice producers. This research addresses the multiple attributes that influence the use of mobile phones such as network creation and individual factors, and specifically focuses on the primary use of mobile phones, that is voice-to-voice communication. As Dey et, al. (2016) states, there is a similarity between the usage natures of these devices across different nations, therefore, any such research which adopts relevant development theories, such as *choice* (Heeks, 2010) and addresses multiple factors, is useful within the context of developing countries.

1.5 Thesis Structure

The thesis is divided into seven chapters. This Chapter one starts with the background of the research that discusses the importance of rice production from the global, and country specific point of view. The research also discusses the information and communication technology (ICT) discourses that show the significance of mobile phones, in particular for the farmers in developing countries. The motivation and aim of the research is subsequently discussed in the relationship between the use of mobile phones as a tool and the importance lies in understanding its impact on rice producers.

The second chapter; the literature review discusses the rice producers as SMEs (small, medium enterprises) and their commercial networks. The chapter elaborates the concept of communication exchange and the role of ICT (information and

communication exchange) in SMEs along with the commercial activities of the rice producers.

The third chapter discusses the theoretical foundations and the overall approach that present the ontology, epistemology and the framework that is developed to analyse the data for the research. This framework encompasses three components that address the research questions directly. The chapter discusses the concept of social capital and *choice* theory in relation to the rice producers of Bangladesh. The chapter also discuss the other key theoretical elements on *structuration* theory, *institutional* theory and the *resource-based view* of the rice producers.

Chapter four discusses the methodological approach and the details of data collection. The chapter also provides information on the data collection site and the support from external authorities for the background data for the research.

Chapter five and six discusses the findings and interpretations of the data. These two chapters are divided by the components discussed in the framework of Chapter 3. Survey and case study data have been distributed based on the aforementioned framework components. These two chapters also discuss the implications of the theoretical discussions in relation to the research framework.

The concluding chapter seven provides the rationale on how this research answered the fundamental research questions discussed in this chapter one. Possible future research and the importance of this research from theoretical and practical perspectives have been discussed. The chapter ends with a summary of the limitations of the study.

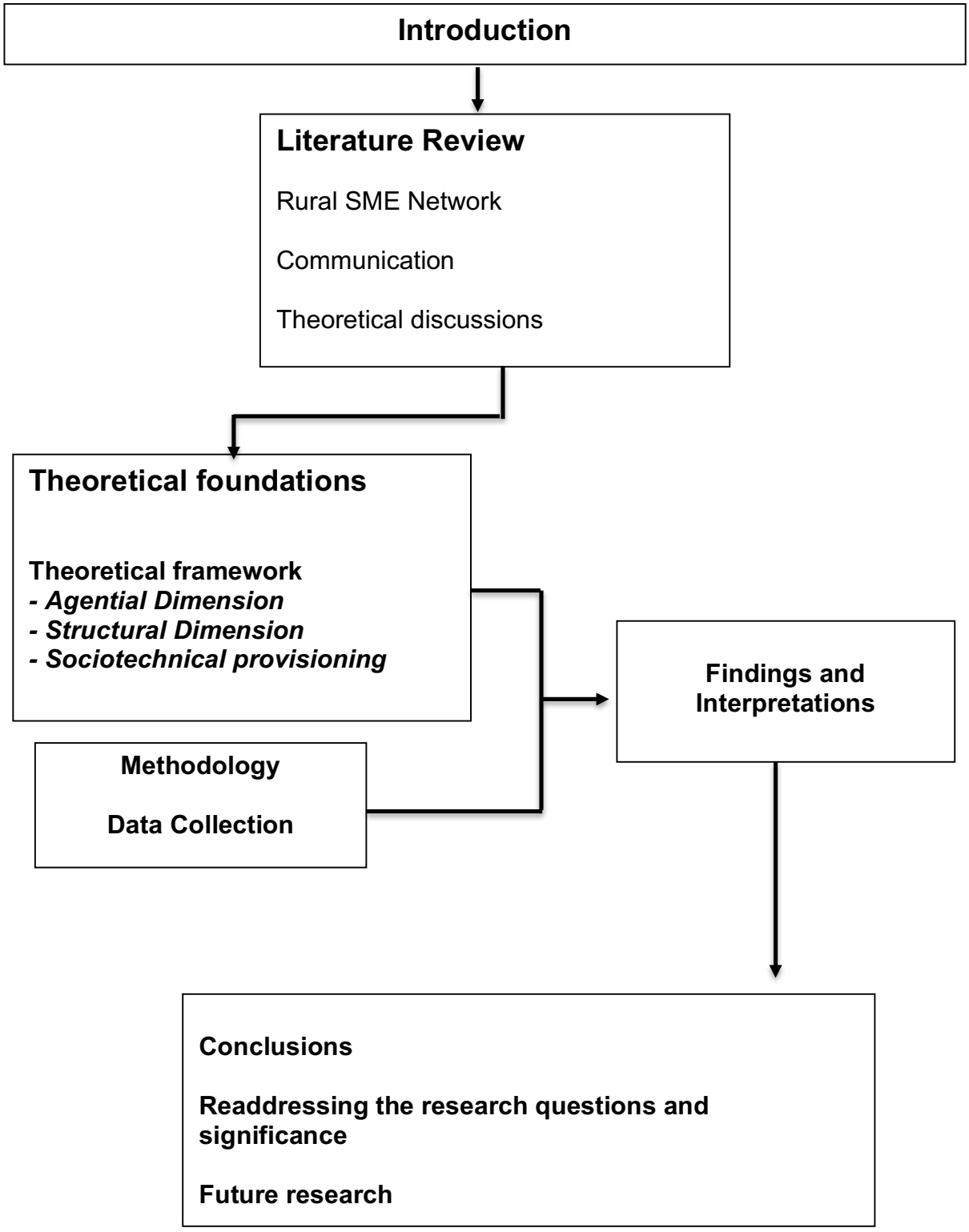


Figure 1.1 - Thesis Structure

1.6 Chapter Summary

This chapter provided the rationale and background of the research. The research problem and aim discuss the literature on the significance of rice production for Bangladesh and examples that illustrate the use of mobile phones as communication medium in less economically developed countries. This chapter broadly highlights the role and importance of technological integration within the developing world's agricultural sector. This work specifically aims to apply this theme to the context of Bangladesh, its rice farmers and their use of mobile communication. In order to achieve this in a systematic and comprehensive manner, it is important to acknowledge and understand the social factors that influence the way that mobile phones are used, and rigorously explain the processes of network creation and information exchange. This ultimately leads to insights into the way by which various forms of capital and resources are created by the rice farmers.

2. Literature Review

2.1 Introduction

The literature review initiates the discussion on the Information and Communication technology (ICT) in the context of developing countries. The discussions elaborate on the use of mobile phones in the developing the world, and the communication process of the rural small to medium entrepreneurs. The rural network and the rice producers' network, along with ICT's role in the creation of these networks is discussed. The key commercial activities of the rice producers have been discussed followed by the relationship between the commercial activities of the rice producers. The following sections also discuss the social capital and its impact on the network. The final section of this chapter discusses some key elements such as the ICT and the livelihood approach, along with interactions between connectivity, capital and resources. The principle of structuration theory has been included in the discussion section as a key influence on the theoretical foundations of this research.

2.2 ICT in Developing Countries

ICT4D (Information Communication Technology for Development) literature is highly influenced by traditional development theories, where European interpretations of development influence the literature, and largely perceive `development' as liberal democracy and economic growth. According to Pieterse (2010), the meaning of the term 'development' has evolved over time. The definition of 'development' was considered by the political economists Ricardo and Marx as economic development. This definition was later influenced by industrialization in central and eastern Europe with shifting emphasis on the relationship between agriculture and industry. The definition of 'development' was also stated to be the remedy for the deficiencies in the overall growth of a country (Cowen & Shenton, 1996). According to Pieterse (2010)

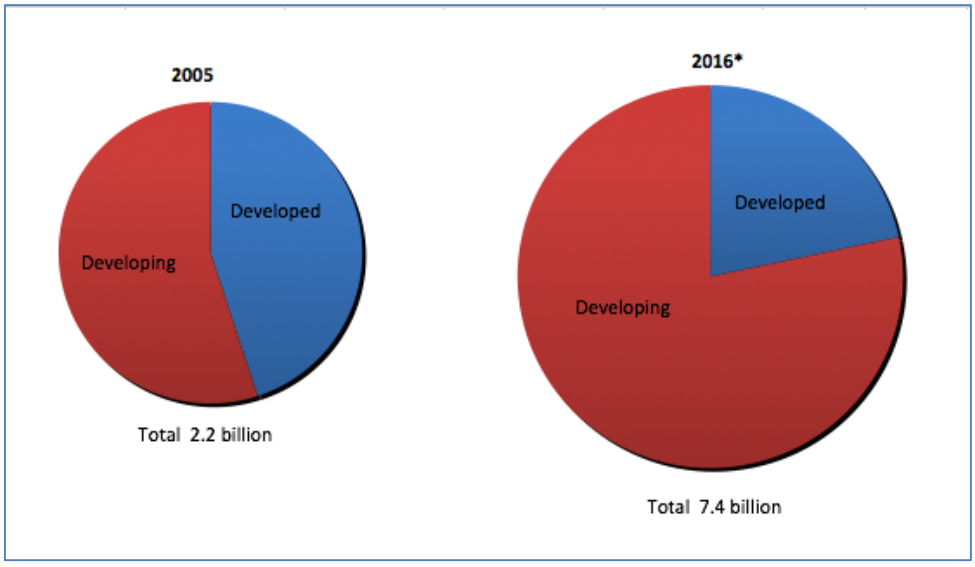
the definition of ‘development’ was later influenced by the colonies established by Europe and later it was shaped by policy failures due to work and social disorders created by industrialization. Today economic growth is referred to as ‘development’.

ICT4D theories, therefore, have adopted a deterministic approach (Granqvist, 2006) whereas in reality, the impact and relationship of ICT and development is hard to determine (Gigler, 2011). According to Gigler (2011), because information and communication technology is dependent on people's information capability, it is difficult to determine how ICT improves people's well-being. The literacy enhances human capability that results in a value addition in people's lives, but evaluating ICT as a capability and linking it to value addition is challenging. However, the field of ICT4D includes other research that is further removed from traditional development theories and moves towards closer economic terms such as quality of life, human development and freedom. These studies of human development in relation to ICT are said to be the most appropriate for investigating the role of ICT in the rural development contexts (Sein & Harindranth, 2004). Other conceptual theories have been developed, with particular emphasis on the interaction between humans and technology in modern society. An example of this is the Technology Acceptance Model (TAM) developed by Davis (1989). The theory specifically focuses on the usefulness perceived by the user along with the motivation and intention behind the use of the technology. The motives and perceptions are primarily linked as a part of human attributes that are influenced by society in general. Research by Bandura (2001) places particular emphasis on how the surrounding society influences individuals as social beings. The knowledge creation and decision-making process of the individual, that impacts their technology use and acceptance, is related to the social cognitive theory (Bandura, 2001). According to Bandura (2001), there is a process of several psychological domains that dictates the way in which individuals reflect on their external influences. This reflection has an effect on how humans function.

Furthermore, there is the agentic view of self in social cognitive theory, that regards an individual, not as a reactive organism to the external influences, but as a self-regulatory and self-reflecting being. Therefore, the individual has the power to influence their actions and produce certain outcomes, as they desire regarding their use of ICT.

Another prominent social science theory, 'social exchange theory' has also been widely utilized to explain how the technology mediates for the individuals, in order to exchange tangible and intangible activities (Cook, et al., 2013). The theory primarily shows how the individual's social behaviour reinforces another person's behaviour, and the social interactions taking place that create the association between persons in the society. Furthermore, from a utilitarian perspective, the adoption of technology has been shown in theories to link with efficiency or effectiveness in the individual's professional or commercial purposes. With the recent widely available and inexpensive mobile phones, particularly in developing countries, the social use of technology is also widely evident. This use of technology for personal gratification is also discussed in literature (Venkatesh & Brown, 2001). The research primarily looks into the adoption of personal computers by 700 participants from work and household settings. The research reflects that the consumers' behaviour when acquiring PCs in the household setting is influenced by hedonic behaviour, more inclined towards entertainment than office use. Furthermore, the acquisition of technology is also suggested to have a social outcome. This social element is linked to the social status achieved by adopting the technology. This social outcome is also related with the power and status that an individual may gain, within their social group. The research relates these two with the motivation theory, where an individual has both extrinsic and intrinsic motivations that influence their actions; the intrinsic motivation being personal gratification, and the extrinsic motivation being the social status.

There has been a widespread use of mobile phones in developing countries that has been associated with their welfare. In ICTD (Information, Communication, and Technology for Development) research, this topic is widely discussed (Donner, 2008). According to the International Telecommunication Union (ITU), global mobile phone penetration reached over seven billion in 2016, or 99.7% of the total population of the world (ITU, 2017). The ITU also found the mobile phone penetration rate in developing countries (5.7 billion) to be higher compared to developed ones (1.6 billion).



(Source: ITU, 2017)

Figure 2.1 – Mobile Phone Penetration

Research conducted by Diga (2013) shows that this penetration in low-income countries differs between nations. In Jamaica and Colombia, the ownership of mobile phones among the low-income group is approximately 90% (Diga, 2013). However, in Mexico, this ownership is around 30%. The research also refers to a study conducted by LIRNEasia (Sivapragasam & Kang, 2011) where it is shown that the ownership of mobile phones in Pakistan, India, and Sri Lanka is less than 25% among the low-income groups of people. Although the ownership of mobile phones is increasing in South-East Asian countries, there is a very small proportion of people who use any

services (SMS and other application based specialized services) beyond voice to voice communication (Zainudeen & Ratnadiwakara, 2011)

Research by Diga (2013) also shows that the mobile phones increase social ties among low-income groups of people and increased employment opportunities. Overall, the research suggests that the use of mobile phones increases social capital and trust in the network. It is addressed that the pre-existing social ties within the poor communities are already strong, due to the need to depend and rely on one another (friends and families) for financial support, and the extent to which these bonds are facilitated by mobile communication is difficult to measure. On the other hand, Waema & Miroro (2014) found that in Kenya during a period of recession between 2007 and 2010, there have been examples of poor individuals moving to non-poor status, who happened to be mobile phone users. However, this improvement was the direct impact of asset accumulation, increased human capital and better infrastructure, and the impact of social inclusion and network was considered to be insignificant, indicating that the impact of mobiles on their improved financial condition was not found. The role of ICT is not restricted to information dissemination. This understanding requires a closer look at an individual's or a community's livelihood as well as their perceived needs and the analysis of information types that are relevant to poverty reduction. The reflection of people's available resources and livelihood strategies play a vital role in the success of ICT.

The connectivity in rural areas, especially in developing countries is often underdeveloped due to the high costs of connectivity in those regions. This difficulty is further aggravated by a broken and unreliable power supply, the low priority for ICT investment and other pressing needs in rural areas. Considering the commercial viability from the operator's perspective, research by Kayani & Dymond (1997) showed that there is a business case for a single phone connection for every 183 people

in a developing country. However, there are development possibilities through mobile phones that require infrastructure to support their growth. This infrastructure becomes difficult as well as expensive to deploy in poor countries, often in geographically challenging rural areas. These areas in developing countries are not densely populated, therefore, it becomes economically challenging for operators to provide network support in these areas. Rural areas also remain topologically challenging for operators to distribute network support evenly; therefore, investment and opportunity costs further rise to provide network service and support. Although developing countries are adopting mobile phones at a faster pace, this adoption is still at an early stage for people in remote rural areas, which are financially disadvantaged. Operators in developing countries increasingly focus on 'economies of scale' and are reaching for more numbers of subscribers; as a result, the 'calling rate' has reduced significantly over the last decade. In India, the calling rate has dropped significantly from $0.20 (per minute) to $0.02 (Kalba, 2008).

From a different perspective, the complexity of the mobile user interfaces makes it very difficult for the farmers to use mobile phones efficiently (Wyche, 2016). Tis is especially because the rural farmers use the mobile phone primarily for voice to voice communication, and not for any other application bases purposes. Therefore, there is a mismatch between how the farmers perceive the use of mobile phones and their design for wider user groups who are capable of advanced usage. This design issue becomes acute for smallholder farmers who suffer from poorly designed application layouts and non-availability of data, further confusing the user (Wyche, 2016). Along with the HCI (Human Computer Interaction) issues, the cost effectiveness of using these specialised mobile applications is also a vital consideration. The research shows examples of Kenya's smallholder farmers' inability to use mobile phones to their full potential as there is a steep learning curve for the farmers to adopt the advanced use for agro-based applications. The debate between the design and development of

application by the service provider and the usability from a farmers' perspective also plays a crucial role in the adoption of mobile-based services by the mass agro-based producers (Wyche, 2016). Therefore, there is a larger debate regarding the effectiveness of such applications in the rural areas. The overall discussion regarding HCI is relevant to question the effectiveness of these mobile phone applications for the rural farmer. However, the benefit of using the mobile phones is dependent on the primary use of the device, not the applications. As discussed in the previous chapter, rural farmers use mobile phones fundamentally for voice to voice communication, therefore, the voice to voice functionality of mobile phone in relation to their commercial context is vital to assess the effectiveness of mobile phones for them. Furthermore, in terms of the traditional trade practices of the rural farmers where trust and commercial engagements play a vital role, a better understanding is required to explore the effectiveness of mobile phones (Burrell, 2015).

According to Aker (2016) there are three major positions in ICTD literature to describe the link between ICT and agriculture. First, the mainstream ICTD discourses show that ICT is linked with the rural users through several advantages such as education, agriculture, health, etc. A straightforward link with ICT and agriculture in this regard is difficult to isolate. Secondly, there are variations in the adoption of ICT within the similar professional groups of people. It is difficult to determine and distinguish the impact on different groups of people.

Thirdly, despite the fact that there are numerous success stories on the usage of the mobile-based programmes in the recent ICTD literature, the cost-effectiveness of such services is difficult to measure. Similarly, individual farmers' cost implications from a communication cost reduction perspective often do not consider their existing social network which may determine their opportunity cost. The initial discussion on the multiple advantages of the mobile phone indicates the potential to create different

forms of resource/capital through the use of mobile phones. However, to be able to distinguish the mobile phone usage and impact on agriculture requires in-depth inquiry into the farmer's phone usage. The mobile phone usage is influenced by multiple factors such as the element of trust. According to Aker (2016) trust is dependent on their face to face interactions with the commercial contacts and also emphasises the factors that influence farmers' adoption of the mobile phone and their commercial trade practices.

The second discussion about variations within the same professional group indicates the importance of individual farmers' capacity to network that impacts the use of mobile phones. Accordingly, to the author, the information gap between the ill-informed farmers and other commercial parties in agro-business is generally presumed to be a fact backed by concepts such as high-transactions cost, capital constraint and oligopsony arrangements (Lopez and You, 1993). To be able to specify the commercial benefit of mobile phones the supply chain of the farmers is important along with knowledge of the exact nature of information exchange. Therefore, respecting the multi-dimensional aspect of farmers' commercial usage is essential to be able to understand the outcome of using the mobile phone.

Based on the discussion of Burrell(2014) the potential benefit of ICT to the farmers is reliant on various factors such as the size of farmers' social network, their ability to create a network, trust and existing trade practices. The author argues the fundamental benefit of the mobile phone is dependent on their capacity to strengthen their social network. Therefore, the bargaining power increases because the information availability is not the centre of their value creation through the usage of mobile phone.

According to the author, the ownership of mobile phones by the female-headed households in the farming profession was limited compared to the male farmers. Furthermore, the existence of limited privacy, independence and literacy are among the causes for the ineffective use of mobile phones by women. The discussion focuses on the social norms or practices that influence the female farmers in their adoption of the mobile phones. Therefore, the gender aspect is vital to be able to understand how the benefit of mobile phones vary depending on gender.

2.2.1 Mobile phone usage in rural areas

Experiential research in Niger showed how mobile phone-led networking has an instrumental effect in reducing price volatility in grain market prices (Aker, 2010). Crop producers benefited by altering crop price volatility by ten percent. The impact is even more significant for areas where transport costs are high. Through all these successes, mobile phone coverage in Africa has grown over the past decade. According to GSM (Global Systems for Mobile Communication), in 2000, the number mobile users in Africa were slightly over 10 percent. In 2008, the coverage in Africa increased to 60 percent of the population, with a total of 477 million people (Aker & Mbiti, 2010). An independent World Bank evaluation showed that $4.2 billion spent on ICT projects in developing countries were “largely unsuccessful” (Dodson, et al., 2012; pp 20). However, telecommunication as a medium has been increasing the outreach at a global level, and therefore broader contextual research would have contributed to this knowledge gap that exists in this area (Cho, et al., 2003). According to (GSM, 2016), mobile technology added a value of $ 3.1 trillion to the world economy which was 4.2% of global GDP for that year. This total value comprises of the contributions from the mobile operators, increased productivity linked with the mobile phones and the indirect impact on the broader economy. Specific to developing countries the use of

mobile banking enabled 1.9 billion people to use remote banking services who previously lacked such access (GSM, 2016). Therefore, it has a broad economic impact on the society and economy in the developing nations.

Rural development discussions use households' finances, political influences and local community structures as important influences (Easterly, 2009).Other elements such as power and wealth also affect the rural community (Castells, 2004). Information access has been widely discussed for its capacity to increase equality in rural areas, where its capacity to bring healthcare, education and general wellbeing (Avgerou, 1998; Heeks, 2002) was the core focus of these discussions. From a rural development perspective, the mobile phone's capacity to provide information in remote areas can arguably enhance 'better living' for rural dwellers. As the Nobel laureate Amartya Sen stated, development aims to bring social opportunities, that are "the arrangements that society makes for education, healthcare and so on, which influence the individual's substantive freedom to live better" (1999, p. 39). To understand how this information through communication can influence individuals in a society, it is important to consider 'social capital', which refers to the trust, norms, and social network, as described by Putnam, et al., (1994), which will be discussed in the later parts of this chapter. In particular, developments through the usage of mobile phones focuses not only on the data, network or hardware of the mobile phone; but also incorporates socio-economic determinants such as people, processes, politics, economics or culture. It discusses the interaction and emergence from the interaction between the uses of mobile phones in the social dimension (Lee & Monge, 2011). In a rural socio-economic environment where people start using mobile phones, it becomes an intervention, where their impact can be analysed by considering the interactions between this technological adoption and social circumstances (Avgerou, et al., 2005).

According to Hudson (2013), Information and Communication Technology benefits rural areas by developing some key commercial aspects of the rural SMEs by having an instrumental impact on improving some specific efficiencies and productivities -

1. Ease of access to price information: Communication media provides prices from different markets available for the rural SMEs, that benefit by eliminating price manipulation by middlemen.

2. Reduction of downtime: The communication technology at disposal aids rural SMEs to immediately seek assistance for any delay caused by broken machineries such as water pumps or tractors.

3. Reducing inventories: The communication allows the rural SMEs to acquire inputs as required. The reduction of stockpiles benefits the producers by not investing in advance which requires added financial investments.

4. Delivery to the market: The use of technology enables the local SMEs to bring products on time without causing any delay.

5. Reduction in travel cost: The availability of communication, particularly through the mobile phones, enables the SMEs to reduce the cost associated with traveling distant places.

The research by Hudson (2013) also shows that there is an energy saving for the SMEs by timely co-ordination with the transport and logistics to avoid wastage on fuel. The research shows an example of a Kenyan company based in a rural setting that sells handcrafted products. The company grew from the US $10,000 company to a $2 million company within two years with the use of ICT that extended a global market for the company. The research also shows the impact of remittances in rural areas of developing countries. There are growing low-skill migrant workers who travel abroad from developing the countries. These workers send money back home, which has a noticeable financial impact in rural areas. According to the research by Hudson, the

global remittance from migrating workers exceeds $100 billion per year. The mobile phone played a significant role in this mobilization of remittance in rural areas.

According to the Bangladesh Bank Annual Report on Mobile banking (Bangladesh Bank Mobile Banking, 2012), a total of eleven banks collaborated with eight mobile phone operators in Bangladesh to provide mobile banking services. Mobile banking as a whole had an important impact for the rural inhabitants in the country. Research by Rahman & Sloan (2015) shows that mobile banking enabled service access to 85% of people in Bangladesh who did not have any banking service previously.

The research also explores the existing wide scale banking services to the rural areas in Bangladesh, which in turn influences other services in rural areas of Bangladesh. Research by Parvez, et al.,(2015) shows that the total value of transactions per day through mobile banking is 47 million USD as of February 2015. These services are provided through agents in the rural areas who receive commission of up to BDT 20-25 (GBP 0.2) by the signing up of new customers. Among these services '*Bkash*' has a total of 58% market share, and a total of 540,000 agents all over Bangladesh that includes all the mobile banking service providers.

The rural SMEs are directly beneficiaries of these services. Research conducted by Hossain & Jamil (2015) on 547 SME owners and managers from rural areas of Bangladesh, show that among the participants, 47.6% were aware of the available mobile banking services. This information indicates a growing awareness of such services in the rural areas of Bangladesh. The research also shows 66% of the participants intentionally used the mobile banking services, which indicate they were inclined to use banking services using mobile phones.

These services enable people living in cities or another country to transfer money to their family and relative residing in rural areas in an easy, low-cost way. As these

services are designed, it allows the individuals, both recipient of the fund and the sender to do the transfer entirely through using the mobile phones. The recipient travels to the nearest agent to withdraw the cash. Services such as bKash do not on directly help the farmers in their income generation but provides a safety net for the rural farmers in case emergency cash mobilization becomes necessary. Similarly, these services also create a safe environment for the farmers to conduct any business transactions with the buyers without having to carry cash whilst travelling which poses the risk of theft, loss or overspending (Miller, et al., 2013).

2.2.2 Information and Communication Process

From an individual's perspective, communication occurs when there are two associated information-producing processes taking place, and the output from one process is the functional inverse of the other process' output. Between two people, this applies when one individual talks and the other listens (Leeuwis, 2004). It also shows how communication and information are not synonymous terms. The communication process creates a channel for information exchanged through this communication process comprised of communication systems. Therefore, this communication occurs when information flows from the input of one process to the output from a second process. When one speaks the other does not perform the same action, but listens. Therefore, communication can be a process of decoding and reconstructing new interpretations (Freire, 2000). For Freire, the process of communication was fundamentally a knowledge creation process. A similar argument was presented by Unwin (2009), who provided a framework to explain the concept of ICT in three sets of interconnected processes:

- The capture of information
- The storage of information
- The ways in which people access and share information

Research conducted by Alampay (2006) showed how the use of ICT impacts individual capabilities. The research shows that this new technology (mobile phones) increases the capability of individuals and alters the frequency of their communication. As people's capabilities increase, they use the technology more frequently. This relation between human 'capability' and the mobile phone is most commonly viewed as a tool in this context to provide access to more resources than were previously unavailable. The technology is location independent and provides two-way communication. These technologies also enhance an individual's ability to send/receive relevant and timely information that can potentially alter individuals' access to key developmental inputs. This leads to the question about how this capability impacts `social capital' in a community.

2.3 The nature of Networks

People, or 'actors', are the most vital element in research on networking. People share capability resources that can be their experiences, skills and the information they are exposed to. An 'actor' comes with various characteristics (Murdoch, 2000). Broadly speaking, these characteristics can be divided into different categories: demographics (age, sex, and ethnicity), individual's position (objective, character or individuality), socio-economic (income, expenditure) and skills (training, experience etc.). This research in particular will focus on rural Bangladesh, where rural entrepreneurs create their networks based on skills. These skills represent their core business or profession.

The mobile users or the actors in a network influence the shape and form of the social spread and the geography of the network. The actor thus serves as an intermediary of the resources that are being shared in the network (Walsham, 1997). The level of interrelation in a network is dependent on the type of network (dyadic, non-dyadic)

and the defining elements of the 'actor' in the network. A dyadic relationship refers to the relationship between two individuals that is intimate and persists over a period of time (Becker & Useem, 1942).These defining elements may influence the 'network', such as the gender, the level of education, marital status and ethnicity. These defining elements were later referred to as 'agency' in the research framework. The approach of social network analysis (SNA) requires information only about the type of network, where additional information such as relationships (e.g., friendship, colleagues, family) and the type of resources or activities between actors (e.g., information, money, materials) are taken into consideration for the further analysis in this research.

Social-network analysis, from an ontological perspective, treats the network as a static phenomenon, where a snapshot of data at a particular time is considered to analyse a social network. Within the network that individual creates, over a period he adds or reduces the social ties that alter the composition of the network. Therefore, the social network and its progression is a complex phenomenon, where the individual benefits from the collaborative relationships. Their emphasis may be driven by the embedded practices of local cultures. Therefore, in a static social network, analysis implies that the actors in the network are not active/adaptive agents, which means that 'actors' are not capable of taking action, learning, and altering network interaction. This research acknowledges the dynamic nature of the mobile-led network created by the rural-farmers that allows individual rural rice growers to communicate with their chosen individuals as they wish. This dynamic nature of their mobile phone network is also capable of showing the changing nature of communication and the precise measure of dyadic and non-dyadic commercial and socio-commercial network ties.
Research by Carley (2001) used multi-agent technology, where the actor in the network is shown as an agent who acts, learns and caters to changes in networks. Carley identified learning mechanisms that dynamically adjust networks, as the agents in them participated, learned and exchanged new information. Networking between

the actors indicates some type of relationship or inter-exchange between them. These relationships can be ‘dyadic’, which refers to a more intense type of relationship such as close family, friends etc. The frequent information exchange between such actors indicates more sharing, and therefore a valuable relationship. The relationship between these individuals can hold multiple roles - such as a commercial contact and social contact. These contacts with multiple roles are referred to as 'multiplex' contacts in network theory, where individuals are frequently interdependent through their communication (Lee & Monge, 2011). Furthermore, multiplex relationships are tied with different types of resources. According to Lee & Monge (2011), there has been little work in this area, namely on structural patterns and the social rules behind the multiple ties between individuals. The research also shows that by learning about the multiplex relationships, the process and pattern of communication between the individuals can be understood. The author investigates the underlying influences such as endogenous and exogenous properties of the multiplex relationship between individuals, where the former refers to properties such as dynamics between types of ties, such as a social and commercial inter-relationships between the individuals. The interrelationships between individuals is subject to the social, economic influences that are part of the structural embeddedness of the individual. Here, the motivation for a multiplex relationship is associated with organizational learning and how their decision is being influenced to create ties. Therefore, this influence primarily indicates the individuals' personal attributes that influence the network. The exogenous element of multiplex network indicates the social rules at the local level that dictate the creation of such types of networks. The individuals from the community with different functions such as friends, relatives or commercial contacts whom the individual exchange resources with are defined based on their association with the individual. These friends, relatives or commercial contacts are interrelated from a spatial perspective. These two exogenous elements (functionality and spatiality) mainly

represent the external influences on multiplex relationships. The dyadic ties between the contacts are logical when they arise from similar individual ties (Lee & Monge, 2011). The research also shows that the multiplicity between individuals can result in an accumulation of collaborative experiences, which can be referred to the endogenous effect of the multiplex relationship, along with an increase in the regional coordination because of the use of mobile communication. Subsequently, the individuals from a small spatial distance create multiple relationships - which is the exogenous influence of the multiplex network (Lee & Monge, 2011). These various patterns of relationship dictate the utilization of locally available resources. With weak ties, despite the potential access to more resources, actors are less inclined to share with each other. They may prefer a new connection that is not directly a friend but a friend introduced by a somebody within his network. This process of connecting with somebody outside the network can be triggered by the intention to seek new information or resources that benefits the individual by extending the structural holes, where the structural holes are individuals who are situated in between two different networks (Burt, 2002). The access to resources translates the 'choice' as an 'outcome' of ICT by Kleine (2010). This 'outcome' also incorporates how the individual perceives the use of that supports the choice they make in order to engage in their livelihood strategies (Kleine, 2010). However, this network has been discussed from rural Bangladesh's context, therefore the nature of the mobile-led network in rural Bangladesh is vital to discuss at this stage.

2.3.1 Mobile-based networks and their impact

Rural rice producers, driven by their commercial or social motives, create different types of contacts (social, commercial, socio-commercial). These contacts, based on the

nature of their relationship, change to dyadic or non-dyadic. All these contacts created by the rural rice producers do not always reflect on their mobile phone network. The rice producers have both face-to-face contacts and mobile phone contacts. Therefore, farmers have two different sets of contacts; physical contacts and mobile phone led contacts, with overlaps between them. The intricate process of information transfer in rural areas is driven through the individuals' interpersonal relationships and the social ties through face-to-face communication. This cultural communication process in rural areas is arranged in accordance with the local participants' interest and levels of mutual trust (Molony, 2009). Research by Lum (2011) showed that the communication between individuals about markets, especially for financially disadvantaged people, was vital for their living. Generally, where rural dwellers in remote areas have no phone connectivity, they find it difficult to access information on basic commodity prices. Without communication mediums such as phones, farmers also suffer from a lack of alternative sources for purchasing fertilizers and finding buyers. Research on South-African rural areas showed that the lack of telecommunications would imply higher physical transport costs for farmers when seeking information (Scott, et al., 2005). Therefore, the impact of telecommunication on livelihood for the rural communities is substantial, where in this case it has a direct effect by saving travel costs. However, all these 'impacts' tend to have a perspective that has a long-term impact, the analysis of which requires studying the extent of mobile phone use and its impact on such types of benefit (such as through mitigating vulnerability, expansion of existing activities, or diversification).

2.3.2 Mobile phone and social/commercial network

A social network connects people by their interactions. In a network environment, if we consider the participants as actors, the relationship between these actors is based on the sending/receiving of messages or conversation (Milgram, 1967). The concept of the complex nature of a network provides additional knowledge on the properties of the dynamic nature of this network. However, this knowledge sharing indicates how shared communication helps people create references for 'sense making' in the process of interaction (Downing, 2005), which reflects their purpose of communication. Whether this communication is based on common actions or experience rely on the meaning interpreted by the 'actors' in a network (Habermas, 2015). This process of communication is referred to as 'typificatory schema', or agreements about the underlying rules of the game (norms, values and beliefs) for social behaviour. However, networks through mobile phones develop many small networks that consist of actors in varying numbers, rather than a big network that connects many actors, where there is no exact boundary for the network to evolve to a wider network. Barabási & Albert (1999) indicated the 'scale free' nature of such social networking. A network through a mobile phone caters for a mixed distribution of connections with different actors who are connected with other different networks. From a network perspective, the contacts are the nodes. In a network, all the nodes are connected to a 'hub'. A 'hub' generally refers to a person who is within a network which has more people connected to him or her. Early research by Goldenberg, et al., (2009) showed the importance of expediting information sharing by 'hubs'. In many social networks, a hub provides more information or resources to other members in a network. There is research that shows that social networking through mobile phones has characteristics where individual members of a network are connected with other individuals who are also linked with another network (Sheller, 2004). With the exponential growth of mobile

phone users, social scientists have carried out several studies to explore society and its various influences by analysing the complex nature of the social network (Eagle & Pentland, 2006). Research by Gonzalez, et al., (2008) analysed this nature by gathering information of mobile users for six months, where there were flows of exchange between hundreds of thousands of individuals. The research showed how these connected individuals, through their use of mobile phones (by connecting with more people), created a high degree of sequential and spatial promptness. This network created social interactions where human dynamics play an important role. Researchers such as Candia, et al., (2008) used mobile-led social networking as a subject to analyse the differential influence of human activity and its impact on social interaction. Researchers were generally interested in learning insights into individuals' habits, attitudes and routines. There are advanced works on the wide usage of mobile phones in academia. However, academic research on the construction and dynamic nature of a mobile-based network where actor's interactions are considered the core subject matter is not widely found (Watts & Strogatz, 1998). Later Gonzalez, et al., (2008) conducted research on local mobile users, considering different variables, and the research highlighted how actor's individual and social profiles influenced the elements of interest to form networks. The research shows social network analysis (SNA), demography and the actor's personal attributes that are considered by actors in choosing nodes to add on his/her network. This shows that mobile phone-based network research where user's data and relevant information is considered can provide insights about the network and the users as a whole. This research uses the actors' past mobile usage data, which provides a basis to understand the correlations between the types of usage and communication of actors. This research shows that a mobile phone network could be developed by encouraging 'homophily' from the network (Lazarsfeld & Merton, 1954). This concept of homophily had two main reasons; one was 'similarity attraction', where individuals connect with other people based on their

similarities (Byrne, et al., 1971). The second was Turner's (1989) theory of self-categorization, where people categorize themselves with other people. Within homophily, communication relationships may vary. Therefore, the concept of a 'dyad' is also relevant in this regard. The concept of dyad was defined by Becker & Useem, (1942) as a relationship that is intimate, close and persists over a period of time between two people. A mobile phone network can have this form of dyad, where the actor's interests are similar in respects such as demographic values. This implies that people from similar demographic background are more likely to have a dyadic relationship. However, homophily over a mobile network can reach more than only two actors, if the information sharing through the network goes by all connected individuals. Research by Richardson (1940) showed the influences for creating a homophilic network between individuals such as demographic characteristics (age, sex, race/ethnicity, education) and psychological elements (intelligence, attitudes, and aspirations) (McPherson, et al., 2001). In mobile phone-led networking, homophilic relations consider actors' similarities in mobile usage patterns where in social network contexts, homophily provides the link between actors in a network based on similarities in selected attributes. Homophilic ties between actors are not based on emotional looseness, and therefore, these ties can be unidirectional.

Communication through mobile phones in rural areas is a possible emergence of mass communication that has proven to be not simply a tool, but a medium that has elements for social construction, with its own implications. Through mass communication, the mobile is linked with an individual's `culture', which emphasizes individual autonomy, and a self-definition as a social actor. Mass networking, on the other hand, has no 'central' mechanism. It works on binary logic: inclusion/exclusion. This provides freedom to individual 'nodes' in the network to either strengthen the connection if participants find it useful and necessary. Therefore, each network creates an autonomous system that by practice, removes a connection if it is not serving

certain communication purposes. In a mass communication scenario, people connect with each other with specific purposes. This can be for social connectivity (Donner, 2008) or to be linked with the individual's interests. If a 'node' in the network ceases to serve the need or usefulness, it might be excluded from the network. This form of communication combines with different motives, some driven by professional interest and some social interest. It also creates new shared cultural codes (Inkpen & Tsang, 2005).

2.3.3 Physical Network with a Mobile Network

From a general perspective, the list of contact numbers in a mobile phone can be considered as existing social ties, which present the simple form of the mobile social network. It is not surprising, therefore, that there is research that explores the importance of contact diaries. Lugano (2008) presented a research used the information from a phone book of thirty participants in Helsinki to assess an actor's personal community. He showed significant overlapping between an actor's mobile social network and the real physical social network. Later, his research compared contacts written on paper to contacts stored in phone books. This research has demonstrated the substantial basis for understanding how the individual's social habits relate to their adoption of the mobile phone. Therefore, historical data of the actor's communications such as phone calls and text messages are utilized to evaluate interlinked elements of a social relationship, such as the strength of trust or bonding in a community. These values are instrumental in measuring the strength and weak types of networks (Lugano, 2008).

2.3.4 Network as a proxy element of social capital and its impact

Communities in rural areas have social capital readily available, compared to urban areas where a widely connected 'weak' network exists because of the high population densities. These weak ties facilitate access to new knowledge that can be obtained outside the network of strong ties. However, in the rural areas, there is preference of strong-ties over weak ties. According to (Granovetter(1973), strong ties refers to those bonding relationships between individuals that spent more time and content exchange. These types of relationships are reciprocal, so these relations indicate bonding such as family or friends where the individual in the network generally invests more time and emotional interexchange. Weak ties, on the other hand, indicate less investment of time and exchange.

Burt's (2009) work identified the locations of individual nodes in a network and how they relate to closeness to a location that is beneficial from a strategic perspective, such as a bridge. A bridge is place where traders gain the benefit of more access to another location that is connected through that bridge. In developing countries, mobile phone networks are deploying faster compared to fixed phone lines. A mobile phone has the element of increasing at a faster rate over a physical telecom landline connection because of its cost effectiveness. Any wire connection goes through every single house, compared to a mobile phone where a tower provides a signal from a nearby area, covering many households. In an early study by Geertz (1978), it was shown that information through communication between individuals, especially among financially disadvantaged people, is vital for living. This is important since rural dwellers in remote areas with no phone connectivity find it difficult to access basic commodity prices. Without communication mediums such as phones, farmers also suffer from a lack of alternative sources for fertilizers and buyers. A study conducted in India, Mozambique, and Tanzania on two-hundred and fifty participants showed a direct impact of limited telecommunication access on the physical transport cost

(Scott, et al., 2005). Therefore, the impact of telecommunication on livelihood for rural communities is substantial, where it has a direct effect by saving travel and associated costs.

Research by Zainudeen & Ratnadiwakara, (2011) showed that the use of the mobile phone is predominantly for social purposes. This research in different regions of India and Sri Lanka showed that the primary usage for the mobile phone is for family connectivity. Thus, there is an element of 'social cohesion' in using a mobile phone, which helps families remain connected. Bayes, et al. (1999) showed in their research from Bangladesh, that the rural family maintains communication with their earning members abroad, since they send funds to the family in the rural villages in Bangladesh. Richardson, (1940) found that the use of the phone among the rural poor was directly linked as a means for their businesses. These entrepreneurs provide call services to the local people in the villages, who pay for the phone calls. The majority of these entrepreneurs are women from local villages who took micro-loans to make the initial purchase of the phones and subsidized call rates. For a disaster-prone country such as Bangladesh, a widespread impact of access to telephones in rural areas evokes a sense of security for the remote users and provides the ability to swiftly act in an emergency. Scott, et al., (2005) showed that the ability to contact someone in the event of conflict, illness or death is an important benefit of mobile phone access in India, Mozambique and Tanzania. In general, people highly value the facility to contact others anytime, anywhere, which is a key feature of mobile telephony. In fact, this important feature of being able to connect with any person has been mentioned as the key motivation for owning a mobile phone, followed by the accessibility of information anytime. In developing countries, the basic use of the mobile phones allows one-to-one communication with immediate feedback, which is otherwise not easily possible through other media. The other media, such as TV, radio or newspapers, involve one-way communication, where an individual cannot exchange knowledge.

Since the mobile phone is widely used at publicly accessible facilities, the telecom service is relatively cheap and doesn't require much education and skills. A mobile phone network is vital not only for the information dissemination to a wider number of people, but for the various other information-based services that can be introduced using this medium. However, mobile phones for rural residents were found by researchers to be financially beneficial, since they directly helped farmers (George, et al., 2011). From empirical research, mobile phones improve market efficiency by changing the traders' marketing behaviours. Traders with mobile phones extended their market by increasing the market contacts, compared to non-mobile phone users of a similar socio-economic status (Aker, 2008). In this research, Aker showed that the usage of the mobile phone has improved rural traders' financial well-being by increasing their sales prices. The effect of these changes brings an increase equivalent to a 29 % increase in income per year. Early research by Joseph, et al. (2014) shows that social contacts and knowledge dynamically co-evolve, where the actors within a network exchange knowledge. This increase in communications among actors both within a network and across other networks reduces communication costs and potentially increases relevant information flow. Among its various uses, the mobile phone can help households obtain information about potential natural disasters, which can help rural people better prepare (Heltberg, et al., 2009). An increase in mobile phone usage raises communications among members of a social network, affecting social learning, which enhances the rate of technology adoption (Bandiera & Rasul, 2006). This new adoption also impacts new behaviour in the trade environment, such as the case where mobile phones provide better access to market information, and farmers can call or text government agencies to ask for technical agricultural advice. Therefore, the debates about using ICT for development changed from a question of 'if' ICTs are instrumental, and moved to 'how' they should be used for development (Walsham, et al., 2007). This question of how the use of mobile phones benefit rural

people depends on the nature of the network they create with mobile phones – uncovering which is the purpose of this thesis.

2.4 Rural SMEs

There is no widely accepted definition of small and medium-sized enterprises (SMEs). The definition of SME depends on characteristics such as the level of investments, number of employees and size of the SMEs. The different brackets of this segregation vary from country to country. The World Bank (IFC, 2010) categorizes small and medium enterprises as those that have a maximum of 300 employees, whereas the European Union (European Commission , 2003) categorizes SMEs as those that have less than 250 employees. According to the Bangladesh Bank Annual Report on SMEs (Bangladesh Bank, 2010), an SME has three broader categories, business, services and industrial. According to these categories, the business SME's value of existing assets between 50,000 TK to 50,000,000 (an equivalent of £436 pounds to £436,000 Approx.) SMEs in Bangladesh generally operate through a one-person undertaking. Therefore, the largest employment category for SMEs is its working proprietors. SMEs contain most of the work force in developing countries, where family members get involved in businesses receiving no pay, and these numbers in the SMEs amount to three-quarters of the total workforce in SMEs in developing countries (Khan, et al., 2012).

It is a common belief that SMEs are primarily retailers and small-scale traders. This is true since SMEs in developing countries are mainly involved in the trade business. Along with trading activities, manufacturing activities are also widely pursued by entrepreneurs in rural areas. Manufacturing activities have a vital role in rural areas, where SMEs participate more compared to urban SMEs in Africa (Wolf, 2001). Among SME manufacturing enterprises, three particular categories have been known as important segments: textiles and garments, food and beverages and wood products. Research by Biggs & Shah (2006) showed that these three categories cover seventy-

five percent of manufacturing SMEs of the urban sector in the African regions. This ratio further increased to nearly ninety percent in rural areas. However, there are variations from country to country and between rural and urban settings. This difference also depends on what types of activities are locally more common and what resources are locally available that dictate the professions of the people. These elements also impact SMEs to adopt businesses based on the skill set and relevance of their product and services to the local market. This availability of resources can vary from country to country, where the raw material availability (such as wood, cotton, etc.) relies on the supply and demand.

Individuals choose entrepreneurial initiatives as part of their livelihood strategy. In the rural areas of Bangladesh, agriculture is the primary livelihood activity (Section 1.1). Other activities in rural areas involve various non-farming activities such as small shop ownership, day labour, retailers, transport and other forms of businesses. Research by Rattan (2014) shows that several individual entrepreneurship factors play a significant role. These factors are -

- Culture
- Government intervention
- Informal sector
- Family businesses
- Historical development
- Demographic differences
- Technological innovation

The SME activities also require financial savings, credit or aid from external sources. Lack of such access creates a `poverty-trap'. This lack of access to financial support creates adverse asset inequality, which creates a barrier for any start up initiatives (Barrett & Swallow, 2006). In a rural scenario, where natural hazards and other crises are common, the lack of the financial support heightens the adverse effect of 'poverty'. Small and medium-sized enterprises are vital factors for any economy. The role of SMEs is significant, as it creates jobs and facilitates necessities for people. However,

SMEs in developing countries face substantial barriers such as financial, technological and infrastructural restraints, especially in rural areas. SMEs are a topic of significant importance in academic discussions regarding economics, as well as its social impact in developing countries. SMEs create employment opportunities for the poor, especially women, who utilize locally accessible inputs and mobilize small and scattered personal savings, develop entrepreneurship, and correct the regional inequity in developing countries (Nichter & Goldmark, 2009). SMEs have a major role in employment creation, poverty alleviation and economic development in a poverty-ridden country like Bangladesh. Since they have a growing impact in the country, the government has given top priority to SMEs, as they are labour intensive (Siddiquee, et al., 2006).

Despite the significant role in the global economy (Morrison, et al., 2003), the SME is the most critical sector for developing economies where size, technology, capital and other resources cause growth constraints. In such economies, the SMEs have an important role in providing goods and services for the society. Research by Bouri et al., (2011) showed that along with financial challenges, local environments negatively influence the development of SMEs. According to the World Bank, the total gap in required finance for SMEs in low-income countries is estimated be USD $700 - 800 billion dollars (Bouri, et al., 2011) .Despite these financial challenges, the rural inhabitants in Bangladesh showed a remarkable capacity to save, which promoted many micro finance institutions (MFIs) to increase their financial lending in rural areas. Although, rural borrowers in developing countries have proven their creditworthiness, they are often rejected when asking formal financial institution for loans. Therefore, local moneylenders that give high interest rates remain their only choice for financial support.

2.4.1 ICT's role in SMEs

ICT has both interfirm and intrafirm benefits. The possibility to improve supply chains and markets are among the benefits of ICT. However, there is heterogeneity in SMEs that impact their adoption of technology (Afolayan, et al., 2015). An assessment by APEC in 1995 on SMEs of Philippines found that these entrepreneurs ranked communications services as the most important input for business. The survey-based research also mentioned that more than seventy percent of traders benefitted by increasing their trade outreach and profits by accessing telecom services. As described in an early section, the constraints for SMEs differ from region to region, between rural and urban areas and between sectors. There are some common factors of SMEs in developing countries. Access to information is considered among these constraints that play a vital role for SMEs (Levy & Powell, 2004). This information has been considered important aspects that benefit the SMEs. As discussed earlier (section 2.2.5), the information exchange between the producers and consumers benefit trade efficiency by building mutual knowledge creation of the product and market. Therefore, ICT that enables such types of commercial ties and the information is essential for SME productivity. It has also been proven to be effective in reducing transaction costs for SMEs. The usage of the new ICTs, especially the Internet, offers increased effectiveness, as it facilitates direct connectivity between trade partners. However, this usage of the Internet presupposes reliable technical equipment and infrastructure, which many rural countries do not have. Recent advancements of mobile phone adoption create opportunities for the SMEs to be exposed to a wider network through voice-to-voice communication only.

Flexibility is considered to be a source of competitiveness for SMEs, compared to larger enterprises (Wolf, 2001). The use of ICT has been proven to be beneficial for SMEs by enabling them to become more flexible by allowing them to maintain faster

and reliable communication channels. In practice, SMEs rely on information systems that are more informal than larger enterprises. The owner, who is also the primary decision maker for the business, generally runs SMEs. ICT benefits small traders with fewer coordination costs, as the decisions are taken by one or few people (Wolf, 2001). Qualitative research on rural South Africa by Heeks (Heeks, 2002) showed that the different SMEs require diverse types of information, since the small traders in developing countries that possess little working capital (which was characterized by Heeks as survivalists) rely mainly on informal sources of information from personal relations; therefore; they rely on 'social networking'. Here, mobile phones benefit these rural initiatives by extending social and business networks. Examples from Africa show the use of mobile telephones also substitute for distant travel by the SMEs and the intermediaries that have access to mobile services given priority by these SMEs (Heeks, 2002).

2.4.2 Networking of small traders in rural areas; theory and practice

Research by (Premaratne, 2001) conducted on the SME network of Sri Lankan rural areas suggests that informal personal networks play an important role in the success of small businesses. The development of small businesses also depends on network linkages. Network linkages can provide extra resources that affect business growth in several ways. Firstly, they help to mobilize resources quickly (Premaratne, 2001). Cromie (1994) argued that a good number of contacts available to small traders increase the chances of acquiring the information and other resources needed at a minimal cost. For small traders in rural areas, networks play an important role in labour and credit markets by providing access to more people for labour support and informal credit arrangements. These small traders' networks also benefit their markets for goods and services. Along with the benefits, there are obstacles in the processes of purchasing and selling commodities in trade, such as issues related with non-delivery

to late payment deficient quality and incorrect quantity. These challenges can be decreased by the trust between buyer and sellers where the SME network can play an instrumental role (Aoki & Hayami, 2001). The network is capable not only in building trust but also facilitates the exchange of the market and technology information (Biggs & Shah, 2006). The greater number of interactions between SMEs are driven by various factors. These factors can be driven by the specific context of clusters or the overall nature of trade where the type, location, and quantity plays a vital role. Therefore, it is important to understand the underlying intentions for SMEs creating networks. Alongside, it is important to explore how and why these SMEs develops and evolve in the SME network (Premaratne, 2001). The benefit of the network created by SMEs is reliant on the supply and demand that have the capacity to create efficient market linkage. The challenges for the SMEs according to Scott & Tarafdar (2014) particularly from a supply chain perspective, is the presence of financial, information and spatial separations. The financial separation indicates the inability to meet the financial need for the input suppliers. The information separation indicates the lack of information on the market. The spatial separation refers to the distance between the sellers and consumers that are which impacts delay and intermediation (Scott & Tarafdar, 2014).

2.4.3 SME's network beyond 'social capital'

Entrepreneurial networks of small traders are perhaps the most unclear of the typologies, as there is often an intersection between the 'business' and 'social' networks in developing countries. Though social networks may not always lead to sustainable economic growth (Meagher, 2006), it has proven to have an important role in businesses, where states and markets are weak, particularly in rural areas (Molony, 2006). The social network between SMEs creates an informal mechanism that provides economic coordination between SMEs to fill the gap that exists in formal institutions

(Meagher, 2006). According to the research, this social network among SMEs is perceived by promoting financial efficiency and opportunities for the SMEs. However, the study expands on the perceived view of the African social network, which is identified with the institutional history of violence, slavery and pillage, and how the network is utilized for criminal activities. The research by Meagher (2006) was conducted in Nigeria among shoe and garment SMEs who used the social capital from a functional point of taking the social network in consideration for creation of social capital. The research found the SME create relationship between themselves, based on the community churches and friendships, resulting in a commercial gain in the form of sharing of materials and equipment. The research shows 70-80 percent of the shoe and garments SMEs in the cluster shared their resources with each other, and this evidence of resource sharing creates collective efficiency among the poor. There is focused research that compares the commercial benefits that some SMEs have gained from networks in rural areas (Meagher, 2006). However, there is also evidence that showed that the network benefit for SMEs is limited in some African countries. The lack of trust between collaborating SMEs plays a vital role, where these SMEs are failing to take advantage of clusters or networks (Meagher, 2006) in such circumstances, despite their exposure to a critical advantage of network relations. This type of trust is integrated into social relationships rooted in 'entrepreneurial networks', although these relationships are social in nature, they facilitate more than the informal enforcement of contracts (de Haan & van Ufford, 2002).

This informal social grouping goes beyond social commitment and benefits their commercial aspect not only among the strong ties but also proven within 'weak ties'. Therefore, the successful relationship that created a commercial success through a network indicates a 'bridging', which is a form of social capital (Putnam, 2000) that also creates 'commercial capital' for the entrepreneurs. This may connect people to remote relationships. those who move in different groups from their own and other's

'structural holes' (Burt, 2009) between discrete groups of people operating in separate social worlds. Therefore, these relationships can be composed of friends and relatives or distant acquaintances.

According to Valkokari & Helander (2007), the nature of the SMEs network is unclear because the process of building the network is uncertain and involves social - psychological dimensions. The nature of networks between SMEs is unclear also because the actors who create these networks do not necessarily share common characteristics. The research further mentions that this lack of clarity in the network by SMEs is due to the dependency on the personal relationships that create the entrepreneurial network. The research focuses on the strategic and knowledge management for SME network creation. It is addressed that research exists on strategic management and knowledge management as separate topics of study, but studies on their integration and impact in the form of network creation is sparse. Knowledge management of SMEs refers to the systematic treatment of knowledge relating to the processes of organization (Valkokari & Helander, 2007). The research elaborates on two types of knowledge management - exploitation and exploration, both of which creates a competitive advantage for the SMEs. The research also highlights the distinction between implicit and explicit knowledge, the former being a practical understanding or know-how and the latter being a strategic perspective, or know-why. According to the author, the SMEs benefits from the network when they generate new knowledge by converting knowledge from implicit to explicit form. As a result, these the addition of new knowledge with existing knowledge benefits the SMEs. This knowledge sharing develops capabilities for SMEs are dependent on the common view shared by the network regarding their aims and objectives. Therefore, the mutual trust between the actors is vital in the SME network (Valkokari & Helander, 2007). These commercial networks are created with a number of individuals with strong 'dyadic' relationships or weak relationships. Therefore, the nature of these

networks is different than social networks that create 'social capital' by building trust and confidence. These networks between SMEs create 'commercial capital' that benefits the SMEs, their trust and long term relationship between the actors within that SME network.

2.4.4 Dynamic nature of entrepreneurial network

Static social network analysis considers a network as a static phenomenon, where it does not consider the actors in the network as active/adaptive agents, which means in a static network, 'actors' are not capable of taking action, learning, and altering network interaction. In this sense, a static network can be contrasted with a dynamic network, where actors are considered adaptive agents. Research by Carley (2001) used multi-agent technology, where actors in the network are showed as agents who act, learn and cater to changes in the network. Carley used learning mechanisms to dynamically adjust networks, as the agents in them participated in and learned/exchanged new information. Mobile phone-led networks can create a complex network topology, in terms of the arrangement of various actor's (nodes), since there is no central mechanism that drives the connectivity between individuals. The limitless nature of this connectivity can be `scale-free', where an individual can connect with many more people over a period of time. Mobile phone networks of rural entrepreneurs have the potential to expand continuously by the addition of any new vertices, as every individual connecting to a network can potentially increase by adding new vertices of a network, where the individual characteristics do not govern the nature of the network as a whole.

Entrepreneurial development progresses through phases, where the network of an actor goes through changes in different phases of entrepreneurial initiatives. According to Premaratne, (2002) in the pre-start-up phase a potential entrepreneur goes through a

series of activities of developing ideas, search information and initial capital and support from friends and families. Furthermore, these contacts and their network in the initial stage is the social network of the entrepreneur. In the next stage, the entrepreneur builds professional network that includes family, friends and the commercial contacts. In the third phase where an entrepreneur establishes their business, their network increases and the overlap contacts also change over time.

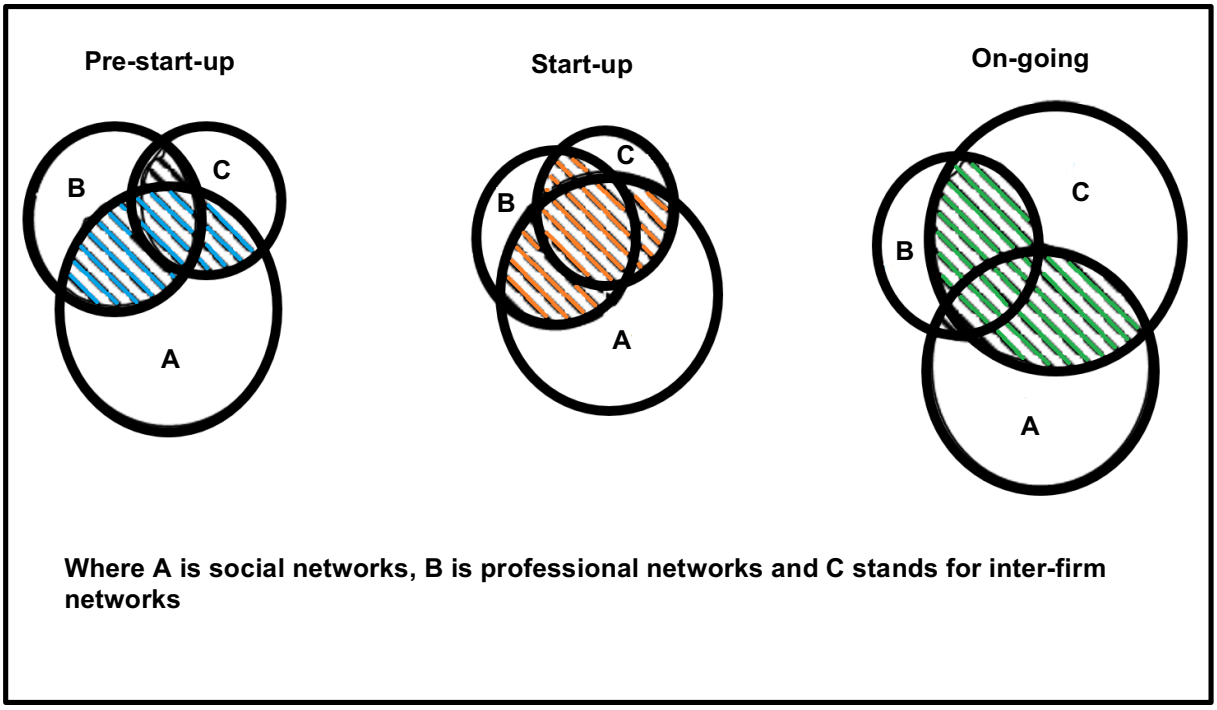


Figure 2.2 – Entrepreneurial development phases – Premaratne (2001)

As shown in the above diagram (Fig 2.2), the SMEs network between social, professional and inter-firm networks evolved over a period of time among Sri Lankan rural SMEs. Here, it can be observed that the SME network increases after an on-going phase; although in the pre-start-up phase, SMEs relied on their social networks for their initial support. The social network remains very limited in the later stage, as more contacts from other SMEs increase.

2.4.5 Farmers as entrepreneurs

World Bank categorized small or medium entrepreneurs involved in the agriculture sector as agricultural SMEs (IFC, 2011). Agricultural SMEs are primarily involved in the production and business related agro-based products. According to the Bangladesh Central Bank (2010) in the non-manufacturing sector, which is primarily the agricultural sector, a small enterprise is considered as one that has less than twenty-five workers and medium enterprises are ones that have less than fifty workers. Based on these categories the rice producers, specifically small and large farmers in Bangladesh fall within small enterprise categories. Specifically, the network aspects that have been mentioned earlier, such as social capital and ICT implications that are applicable to the rice producers' as they operate in rural areas in Bangladesh with common challenges and opportunities like other types of SMEs. Despite various rural challenges, SMEs comprise more than 75% of the economy of Bangladesh. Various categories of SMEs together contribute between 80% to 85% of industrial employment and 23% of total civilian employment for Bangladesh (Islam, et al., 2011). Comparative research shows that the SMEs with 2-5 people contribute more than 50% to the economy of Bangladesh (Ahmed & Chowdhury, 2009).

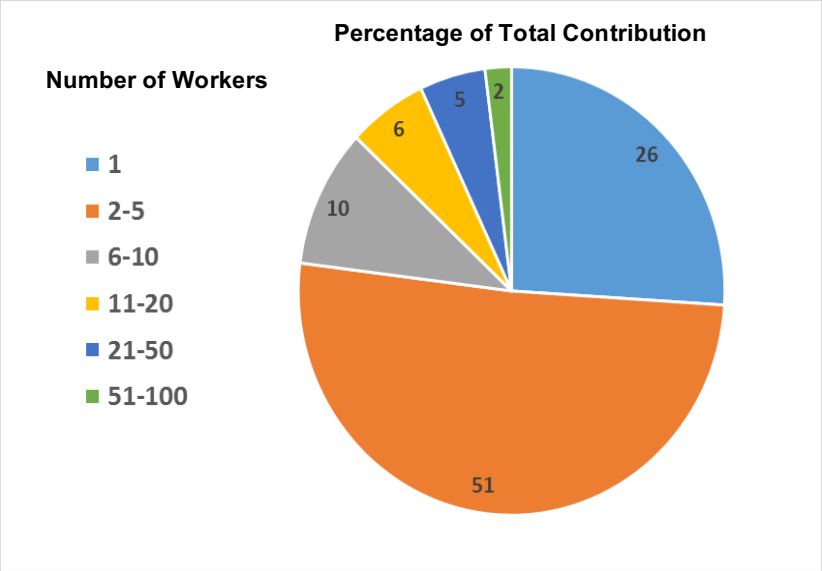


Figure 2.3 - SME contributions towards economy- Ahmed & Chowdhury (2009)

Further research on SMEs shows that among the various types of SME activities, manufacturing and agriculture make up 85% of total contribution with a total of 2.3 million people (80%) of labour force involved in the agribusiness in the country (Afroz, 2012). However, the agribusiness in broad category encompasses not only the production, but also the related activities such as processing, transport, and procurement of raw materials. Within the agricultural sector 80% of the total irrigated area is planted with rice with a total of 60% rural employment (CIA, 2016). Successes for these SMEs are usually the outcome of the way of doing business and co-operation (Altenburg, 2000). This indicates the relevance of inter-SME cooperation along with other factors such as performance measurement and flexibility, which may play an important role in business success. These SME collaborations contribute positively to gaining institutional acceptance that also assists SMEs in developing a desirable marketplace reputation. From a functional point of view, SME cooperation with each other has the potentials for the SMEs to develop its strategic location, reduce transaction cost, adapt to change and develop new skills. Earlier research by Nah et al, (2001) showed that communication with partners, customers, suppliers, and employees are among SME's critical success factors. This research found that networking for SMEs was a critical success factor for their trade; therefore, it is important to understand how this communication and network impacts SMEs.

Access to information is among the major barriers faced by small businesses in developing countries (Kartiwi & MacGregor, 2007). This is especially so for SMEs, as businesses are run by a single person most of the time, and access to information for that one individual becomes a vital decision-making factor their businesses. Lack of data sources available to these SMEs worsens this problem of information access. Technological and infrastructural challenges further degenerate the information-related challenges for SMEs (Sawyer & Rosenbaum, 2000) in Bangladesh. ICT-based facilities that propel business growth faster, such as the usage of e-commerce to

develop SME strengths, face severe challenges in developing countries such as Bangladesh because of the barriers that exist locally and nationally (Kapurubandara & Lawson, 2006). In order to ensure the advantages of e-commerce facilities, such as faster service and shipments and precise transmittal of orders, it is important to have an efficient telecommunications structure, which remains a problem in many developing countries (Belisle & Czinkota, 1999). With the recent steep growth of mobile phone ownership, the necessity for connectivity has been resolved in many developing countries, but the quality of the transmission still faces difficulties when attempting to obtain information from local or foreign sources and effectively using the internet (Sawyer & Rosenbaum, 2000).Therefore, the lack of reliable internet connection, and the cost and reliability of telephone links negatively impacts the networking and communication prospects in Bangladesh. Bangladesh is a country of I63 million people (2015), 66% of which live in rural areas (World Bank, 2016). The majority of these rural inhabitants directly and indirectly depend on agriculture or related activities. In the total population, agriculture, forestry, and fisheries occupy 48% of the total labour force. However, as discussed in the previous section, these occupations are highly vulnerable to natural calamities such as floods, cyclones, draughts, etc. which occur every year, affecting rural dweller's livelihoods in Bangladesh. Flood negatively affects agriculture, communications, livestock and livelihood for rural dwellers. It also affects land ownership in rural areas; therefore, flooding plays a vital role in rural poverty.

2.5 Key Commercial activities of the rice producers

The commercial activities of the farmers are driven by the nature of their business that requires farmers to engage in the process of rice production starting from sourcing agricultural inputs, preparation of the land, cultivation practices, harvesting and selling the produce after harvesting. Because of the perishable nature of the produce,

the farmers sell the produce in a very short span of time before the produce deteriorates by insect infestation or damp that may cause a significant loss for the rice producers. The rice production business is also capital intensive, so the sale of the produce is important for the rice producers to be able to pay off the debts and historically has led to unequal trading relation, high rates of interest, and financial debts. Therefore, the key commercial activities can be broadly categorized with three periods of the rice production cycles. During the land preparation stage, the farmers source the inputs such as seeds and fertilizers that are necessary for that stage. The second phase is maintaining the land that also requires sourcing further fertilizers, pesticides, etc. The third and final stage is the harvesting phase where the farmers harvest the produce, store and engage in selling the produce at this stage.

2.5.1 Input Price, Cost and Wages

Critics of ICT4D discourses argue that processes of social interaction reaffirm structural factors of inequality and exclusion that constrain and even cripple the possibilities of changing unequal power relations for the poor. The role of ICT is not restricted to information dissemination. This understanding requires a closer observation on the livelihood of the individual or a community and their needs to understand the type of information that will empower them to cope with the challenges.

From the rural agricultural perspective, poverty compels rural inhabitants to choose agriculture to avoid distress caused by poverty. The research by Roy et al. (2015) on 378 households in Bangladesh shows that the farmers suffer from acute shortages of cash in the peak season as they were not employed in the lean season. This lack of cash consequently bars them from accessing fertilizer, quality seeds required to achieve the desired yield. As a result, non-farm income generated by the rice producers becomes the source for them to access inputs and resources for their production.

However, research by Reardon (2012) shows that 24% of the traders give loans to the rice producers in Bangladesh. Although not sufficient for the rice producers to cope with the cash required, the availability of mobile phones along with competing traders in the same commercial networks provides more finance option for the rice producers (Reardon, 2012). These indicate the role of mobile phones in providing a tool to support rice producers in situations of poverty.

The inputs that refer to the seeds and fertilizers are vital elements for cultivation and harvesting. Along with the inputs, the other costs for the rice producers includes labourer wages and transport of produce. According to Danielsen, et al., (2005) non-availability of certified seed forced producers to use their own seeds reaped from their rice production. The own seed is vital for rice production in Bangladesh. However, the own seed has declined from 27% in 1999 to 24% in 2009. Furthermore, there is a stark contrast in own seed dependency in neighbouring comparable rice producing nations; the use of own seed consists of 75% of farm budget for Bangladesh rice producers compared to 22 % in India (Reardon, 2012).

The research also states that the Bangladesh Agricultural Development Corporation which is the government seed supply agency, provides 25% of total seeds in Bangladesh. Regarding fertilizer, the research shows that the government plays a minimum role in providing fertilizers (1%). With regards to wage, the average farmers' daily wage is $2.2 per day and a total of $371 per hector. The rice producers of receive a total of 170 dollars per tonne. These two elements, the inputs and wage are the major cost components of rice production. The rice producers share 40% of the total cost margin (Reardon, 2012), and the rural profit margins are 2-3 times higher than in the capital city, Dhaka. This indicates the opportunity for the rice producers to bargain for rice price.

2.5.2 Rice Producers' Supply Chain

Studies on the Bangladesh food supply chain claim that there are many intermediaries involved (Crow, 2001). During the research field visits by Crow, five types of intermediaries in the agricultural distribution channels were identified, who work as organized networks of small traders in rural areas of Bangladesh. The farmers struggle to main their livelihoods in rural areas, which forces them to borrow during the production phase. This practice influences their network and alters their livelihood. Research by Rahman, et al.(2005) showed that 63% of the farmers had to sell 58% of their produce in the harvesting season. Researchers have shown how the big rice traders and mills control indirectly by making the trade credit harder for smaller traders and pre-harvesting loan to the farmers (Crow, 2001). Furthermore, there are geographical isolations from the market, especially in the monsoon season. Therefore, the geographical and credit hurdles unsettle the local rice market during years of poor crop yield. These conditions also influence the number of participants in the market. With the growing output of rice, the surplus rate for the market of rice increased from 12 % in the year 1960 to 49% in 1990 (Reardon, 2012). Furthermore, one-third of the rice producers are net rice sellers, and there is a large number of rice farmers who sell paddy to the mill. Government intervention in the market mechanism has declined over time, with the research indicating that the government had 9% market share in the rice grain import market; that declined to 2% in 2008. The market share for paddy represents only 1%. Therefore, the key players in the value chains are the local buyers, wholesalers, mills, city wholesalers and city retailers. In the process of selling the rice to the mill, there are middlemen in the market. According to Reardon (2012), in Bangladesh the direct selling to the mill by the rice producer and avoiding middlemen represent 30% of the total sold grain to the mills. This number is low compare to China that represents 63% of total grain sold to mills bypassing the middlemen. The village traders in Bangladesh play no role in the rural wholesale market in paddy

supply. The rural wholesaler directly buys rice from the farmers in the rural areas. Among the rice produces 30% goes directly to the capital market of Dhaka from the small rural mills. The rest of the produce goes to the urban market through the rural wholesalers. The research also shows that the village traders in Bangladesh sold 28% of their paddy to the rural wholesale market and a majority of 63% of the small mills. This market integration also stresses the communication between rice producers and the existing market participants. 80% of the rice producers in Bangladesh according to the research own mobile phones, and 70% of these rice producers communicate with their commercial contacts using mobile phones (Reardon, 2012). The study also shows that 58% of the rice producers agrees on produce price over the phone and 90% of the users use mobile phones to respond to buyers' calls.

Grameen Phone in Bangladesh was the pioneer mobile operator that played a vital role in the development rural mobile connectivity, by providing mobile telephones to the village women at a subsidized rate. These 'village phone ladies' provided phone services and generated net incomes of $624 per operator (compared to Bangladesh's GDP per capita of $262) (Forestier, et al., 2002). The use of mobile phone service earlier shown (section 2.2.3) to have assisted micro entrepreneurs in developing new business connections, where these services were the first and only medium to access the telephone. This finding is consistent with Goggin and Clark's (2009) research of how the mobile phone can enable wider connectivity, where the individual gain access to communicate with more extensive local, regional and national networks.

The ITDG (Intermediate Technology Development Group) in partnership with two NGOs established ICT centers in outskirts of the Sadarpur and Dinajpur of Bangladesh in 2002, in order to provide business expansion services to the small traders (Raihan, 2011). According to the findings of Raihan (2011), the people affected by poverty depend on their social network for access to information. Furthermore, the

information is circulated orally and the span of their network correlates with the amount of information they have access to. This is especially true for intermediaries in the trade supply chain that make links between farmers and consumers in Bangladesh. These intermediaries in the supply chain are a function of accessibility to the market. According to Reardon (2012), the value chain of the rice producer is grouped into four types:

1. A traditional value chain of rice has a short geographic and intermediation distance. The paddy comes from local rice farmers which is them de-husked in a local mill and sold in the local village market. The buyers are generally local consumers.
2. A value chain that connects rural rice producers and urban markets. This type of value chain has a long geographic and intermediation span. The rice farmers sell their paddy to local village trader. The local village traders then either sells the paddy or uses local mills to convert it to rice, and subsequently sell the rice to the rural wholesaler. The rice is then sold to city retailers.
3. Long geographic distance chains with medium intermediation span, where the rice producers' sell paddy to the mills. The mills sell the rice to city wholesale traders. This type of value chain can also occur through the rice producers' direct sale of paddy to the rural or city wholesalers. The wholesalers mill the paddy and sell rice to the city wholesale market. The rice is then sold to the city retailers.
4. Geographically long but short in intermediation span value chains where the rice producer sells the rice directly to the mills. The mills sell the rice to the urban wholesale market, which is then sold to the urban retailers.

There are five intermediaries in the major distribution channels who work as an organized network of small traders in rural areas of Bangladesh. Below, their

descriptions and type of work have been described. Farmers sell into a market system made up of the following main actors:

Faria: These are small traders who deal in products within three or four local markets and handle a small volume of product. They are responsible for bulking production by making product purchases from farmers and sell that product either to the beparies or the consumer. These traders usually are small farmers whose farming does not involve full time work on the farm and who complement their livelihoods by diversification into trading (Tasnoova & Iwamoto, 2006). Their volume of business is small because they possess little capital.

Beparies: These are local professional traders who purchase agricultural product from the farmers or farias from the local market or in the village. They handle larger volumes of product than the faria. Beparies sell their products to arothdars (large scale retailers). The Beparies in occasion maintain the farias with agreed upon contracts.

Arothdar: These are commission agents with establishment in the local market. The arothdars primary trade with different beparies and the retailer and charge a commission by providing storage facilities.

Retailers: These are the last link in the marketing channel. They buy product from beparies through the arothdar and sell them to the consumer. The extent of their procurement from the arothdars varies based on their business outreach.

City-retailers: The city-retailers are direct sellers in the main cities who buy from selected big farmers and from arothdars in the rural areas.

Transporters: There are organized transport facilitators in rural areas. They provide transport from the field to the market. Some transporters also provide

transport facilities to the cities. Generally, big farmers require transport facilities for their produce.

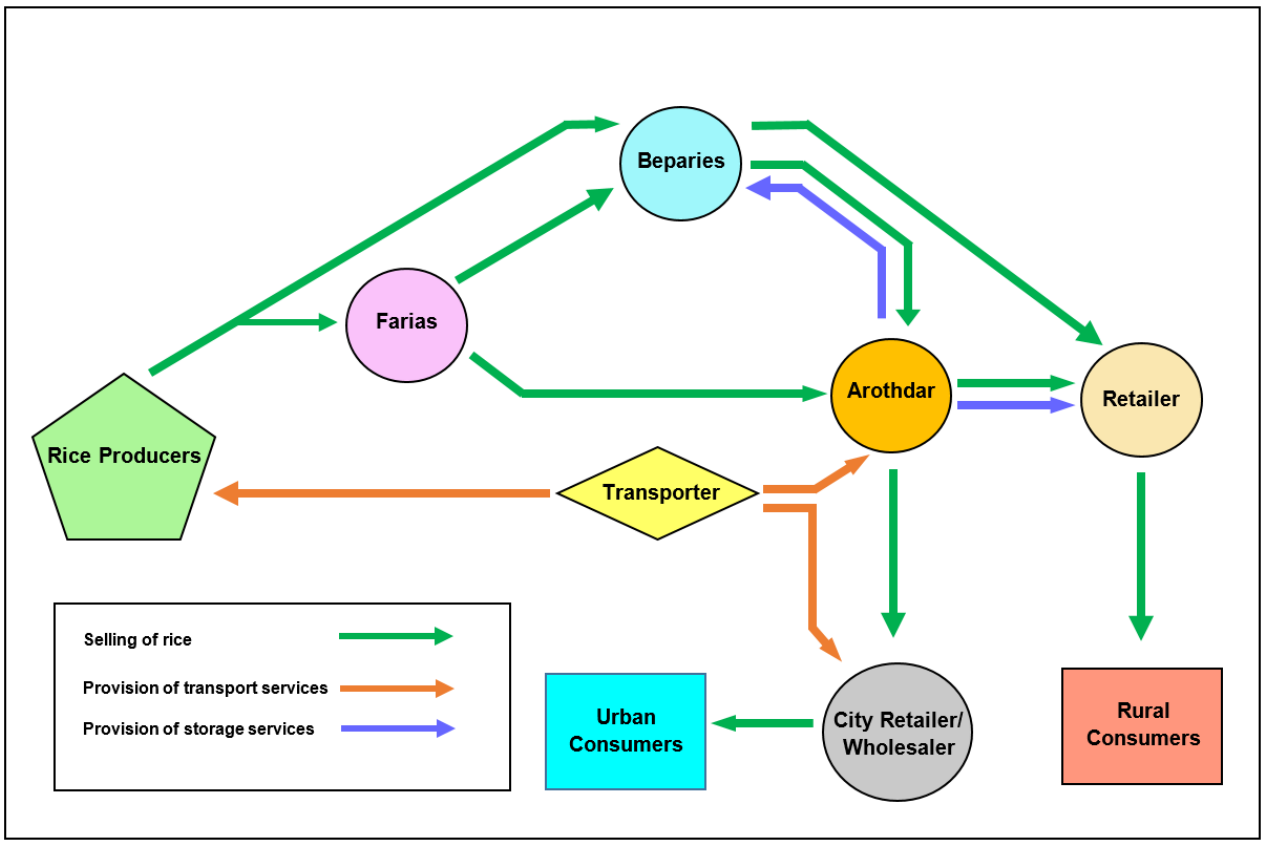


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Figure 2.4 - Rice producers' supply chain

The above actors in the supply-chain connect through formal and informal channels. There are a number of alternative networks and actors that play an important role in creating the supply chain for agricultural products such as farmer cooperatives, producer companies, self-help groups and contract farming, which are instrumental in integrating small producers into the value chain. These rural dwellers, however, are not expert users; they use the mobile phone essentially for information exchange using voice calls (Zainudeen & Ratnadiwakara, 2011). Research by Jensen (2007) in Kerala on three hundred fishing units over the period of 1996 to 2001 and thirty-five beach market shows the usage of mobile phone reduce price difference and decrease wastage of fish. Furthermore, it improved efficiency and profit for the fisherman. Therefore, it

strengthens supply chains in the fishing business that impacts the livelihood of the fisherman. Asenso-Okyere & Mekonnen (2012) compiled studies around the world on ICT and its role in agricultural supply chains, showing that mobile phones reduce search costs for the farmers in Niger by 10%. In Uganda from a panel data between 2003-2005 on the banana, producers show a selling outreach increased by 20 miles by using the mobile phone. In India, there is an example from Tamil Nadu district the intervention of ICT-enabled 15 % higher profit for the farmers compares to the non-ICT users. Another example from India shows a specialized application that provides advice services for the farmers, showing that 67% participants increased savings using the application compared to the non-users. These results indicate mobile phones not only expanded markets but also improved livelihood for the farmers (Asenso-Okyere & Mekonnen, 2012).

Along with the above informal market chain that is created by small traders' organized network, there are a number networks that play an important role in creating the supply chain for agricultural products such as farmer cooperatives, producer companies, self-help groups, and contract farming. These networks have delivered good results in terms of integrating small producers into the value chain. The impact of government through subsidy policies to protect these small traders in the supply chain has proven to be successful to fight against the competition of large-scale operations (Islam, et al., 2011). Micro financial institutions such as BRAC[1] play an important role in this aspect by providing credit support to small traders.

Historically, small farmers have relied on the intermediaries for selling produce to buyers despite being economically disadvantageous (Alam & Wagner, 2013). Furthermore, the information from different markets provides a better opportunity for these farmers that provides a fair price on produce and decrease the strength of these

[1] BRAC is an international NGO established in Bangladesh.

intermediaries. Therefore, information and communicate technologies (ICT) that give access to communication with a wider market creates a better linkage between the producers and the buyers and gives the producers the choice to select profitable options. The research by Alam & Wagner (2013) also argued that ICT lowered information search costs, resulting in reducing transaction cost for the producers. The use of ICT also provides the farming related knowledge that positively impacts the crop yield.

Some of the aspects of the mobile telephony and its impact on the value chain have been discussed later where the farmers utilize mobile phone for the activities related to the actual commercialization of their crop. A particular example from Tanzania shows the farmers has utilized the mobile phone to communicate and conduct businesses for sourcing agricultural inputs to sell produces (Hellström, 2011).

2.5.3 Rice Producers and Land

Rashid et al (2014), conducted a research jointly with BIIDS (Bangladesh Institute of Development Studies) and International Rice Research Institute (IRRI) with a sample of 1,240 rural household spreading across 57 districts of Bangladesh. The data covers a decade timespan from 1998 to 2008. The data shows a change in livelihood in rice producers, with a decreasing income dependency on agriculture; 58% in 1998 to 45% in 2008. Research by Ahmed, et al. (2015) states that the shift in livelihood has a direct relation to the farmers' share of income generated by agricultural activities. This study was conducted on 550 farmers in Bangladesh and shows that the average operated land that the farmers use for rice production is 0.45 hectares. This low amount of land does not generate sufficient income for the farmers and compels them to search for alternative sources of revenue. The landholdings for farmers, therefore, has a significant role in their livelihood. The land used by the farmers is classified into

two types; operated land and owned land (Rashid, et al., 2014). Operated land is categorized as the sum of owned land and net leased land for cultivation. The leased land includes a number of varying arrangements; both leased in and leased out land, incorporated crop sharing or cash payments for the leased period. The owned land refers to all the land under household ownership (Rashid, et al., 2014). The research also shows that there was a decrease in the share of occupied land among large farmers from 37% in 1988 to 18% in 2008. On the other hand, the small farmers occupied land increased from 24% to 33%. Furthermore, 82% percent of agricultural production in 2008 came from farmers operating with less than five acres of land, which was 63% in 1988. The data also shows there is a decrease in cultivable land owned by the household, the ownership of 59% of land represented 13% of households in 2008, compared to 19% in 1988. Based on these statistics, 57% of rural households in Bangladesh are landless. The landless are categorized as marginal farmers and the total distribution from a functional point of view represents 26% marginal farmers, 44% small farmers, 21 % medium farmers and 9% large farmers (Rashid, et al., 2014). Despite the decrease in poverty and increase in rice production mentioned earlier (section 1.2) the farmers are becoming land poor.

2.5.4 Social network and social capital

Rural rice producers, as part of their social surrounding, have access to different sources of information from neighbours, family members or friends. Interpersonal face-to-face communication is the primary source of information of these farmers. Research conducted on six hundred farmers in Bangladesh shows neighbours; agricultural extension officer and input suppliers are among the major information providers of the farmers (Hossain & Jamil, 2015). This connectivity with the social surroundings also has significant influences by the level of trust, proximity of these rice producers. Sen mentioned that ‘’no individual can think, choose, or act without being influenced by

the nature and working of the society around him or her'' (Sen, 2002 ; pp 80-84). The capability approach, according to Sen, depends on community acceptance and democratic processes, and therefore, it is a group-based phenomenon (Sen, 2002). However, the relationship between individual `capability' and group organisation in a society is not an evident fact. This initiates the discussion of bonding or collectiveness in the society, where the term 'social capital' is widely used. Robert Putnam used the term social capital associated with trust, norms, and social network (Putnam, 2000), which are well cited in academic discussions. Putnam through his theorizing referred to social capital as 'features of social organization such as networks, norms, and social trust that facilitate co-ordination and co-operation for mutual benefit' (Putnam et al, 1993, p. 35). Networking, according to Bourdieu, is a fundamental element that generates both trust and norms in society (Lin, 1999). In a different study, Putnam (2007) interpreted social capital as 'social networks and the associated norms of reciprocity and trustworthiness' (p. 137). Research on rural development and social capital showed networking impacts individual livelihood and enables people to acquire different forms of assets. `Livelihood', as discussed by (Bebbington, 1999), is a means for people to acquire and deploy different forms of assets. As discussed earlier, in rural areas of Bangladesh, the majority of people are actively involved in agriculture-based activities. Therefore, their livelihood is closely linked with natural, human, commercial and social capital. Since there are limitations of accessibility of resources in rural areas, acquiring natural resources helps rural dwellers in a material sense, if not utilized directly by the asset-holders for agricultural purposes. For example, if a family in a rural area owns a small piece of land and does not utilize it for any agricultural purpose, it still benefits the family as a long-term financial security, and for rent income. However, there are limitations of choices for livelihoods in order to avoid poverty in rural areas: natural assets such as land are limited to small parcels, with little opportunity for farmers to expand their natural resources base.

These forms of capital for livelihood give them the capability ‘to be’ and ‘to act’. As Sen (1999) noted, it gives the capability to connect productively with the world. This also applies to other types of capital. Apart from social capital, all other forms of capital have widely cited definitions. There is proliferation of research on social capital, with no accepted set of indicators that define it (Fukuyama, 2002). Fine (2003) describes three forms of capital as: natural, physical and human. Social capital seems to comprise everything, such as public goods, networks, culture, etc. Social capital theorists use a positive functional element to analyse economic performance or growth of a community (Fine, 2003).

This diversity of opinion about social capital is based on the meaning, content and economic outcomes perceived by the scholars (Monge, et al., 2008). Furthermore, there is also a division between how social capital is perceived; either as holistic characteristics of a group or as an individual attribute obtained from social interactions. Therefore, it can be seen from an individual's perspective or a group perspective. In this particular research, the social capital is perceived from an individuals' perspective that the rice producers acquire by interactions with the social and commercial contacts.

There is a distinct difference between an individual’s freedom and capability and a collective group of people (Bebbington, 1999). A collective capability improvement addresses both individual and collective freedom of choice. Therefore, the difference with individual capability is the method through which this freedom or capability is obtained and how the benefit is not restricted to individual benefit only. Fine (2004) showed other elements that affect social capital, such as dysfunctional families, bad-schooling etc., which are not specified in the broader term of social capital. Therefore, there are ambiguities and a wider scope attached to definition of social capital, specifically regarding the element of ‘proxy measure’, which is necessary for assessing

social capital. A research conducted by Ulzurrun (2002) carried out on a wide group of people with the political/non-political association across countries. The study shows varied membership associations with the same non-political group between different countries. These proxy measures used for addressing social capital can be relevant for one particular social aspect and irrelevant if applied in a different socio-economic environment (Ulzurrun, 2002). Fine's (2003) criticism of 'social capital' focuses primarily on perceiving economy and society as a sum of people and regarding the development problem as a coping problem with market imperfection. Simple elements such as 'child education' play a role in rural areas, which seem to be missing in the political and macro-economic arguments. Similarly, research on 'gift giving' (Bellemare & Shearer, 2009) discusses how a gift given to an individual creates an obligation to accept; therefore, the receiver must give in return. Relating this back to the concept of social capital that uses `gift exchange' impact on individuals in a community, the concept of social capital includes a responsibility to reciprocate and respect future requests from the other person for assistance and increases the value of an individual's connectivity. However, this qualitative nature of social capital's definition was criticized by Fine (2003) as a 'chaotic' concept. It was considered chaotic because the definition of resources in social capital is considered a physical asset in conventional capital. Similarly, it does not have similarity with human capital, where it refers to the relationship or the synergy from a relationship (Navickas & Malakauskaite, 2009).

Research by Grootaert and Bastelaer (2001) showed that social capital has a different level of impact on individuals. According to the author, at the micro level, social capital discussed primarily from Putnam's work (2000) related to individual and household level. The wider level explains the individual's association with the larger community, local and informal hierarchical relationship (Grootaert & Van Bastelaer, 2001). Therefore, analysing social capital requires identification and unpacking of the relationship between both micro and macro level interactions of the elements.

This requires individual actors and their patterns of relationships with other actors within the network in which they exist (Rowley, 1997). This leaves the question of how information creates social capital for the individual. Information flow is dependent on the strength of a social network. A social network also influences the new connectivity that adds more channels for information sharing. This aspect of a network's intangible value addition exists in developing countries (Biggs & Shah, 2006). Social capital incorporates bonding and bridging between people, which has a positive effect on knowledge exchange in networks. A well-connected community that shares norms and values, such as trust, increases the likelihood of knowledge exchange between people who are connected. This also creates social obligations that can change into economic capital. This connection between the individual and group can lead to sharing access to certain benefits available, which benefits the entire group of people. This obligation causes reciprocation with a similar action by members within the network. Das argues that social capital as the concept does not affect the inequality that exists in power or resources but rather reflect on the interactions that exist in these two aspects of the society (Das, 2005). Along the same discussion, it is imperative to identify the informal information flow that responds to the specific needs of actors in a network. As a social network provides access to resources for individuals through the network, the possibility of a collective goal achievement is slim if there is a limitation of resources, no matter how strong its internal bonds. This interconnection or network through a mobile phone facilitating effective result for individuals within the network can be expected to vary from individual to individual. These interactions between individuals and their relations are likely to create an opportunity to access and use bridges to reach to resources that were previously out of an individual's reach (Gulati, 1999). With more people in rural areas connecting through mobile phones, transformation of social connectivity is increasing rapidly. This wide diffusion has led to the development of horizontal

networks of interactive communication that connected greater numbers of people, therefore increasing 'local' connections of individuals. From Putnam's research (2000), the impact of social networks benefits individuals and the people who are linked within a network, since it creates `trust' and leads to information exchange and communication that leads to better coordination in society. This coordination increases knowledge sharing in social, political, professional and other aspects; therefore, it increases the collective benefit.

2.5.5 Seasonality and communication

Banerjee (2010) showed that Bangladesh is among few countries that are affected by annually recurring floods. The research shows that the water rise in fifty-four prominent rivers creates the floods in Bangladesh. According to the research, in the pre-monsoon season flood starts between April and May from the hilly east and north-east regions. The Monsoon occurs from June to October, caused by river overflow and rainfall. Particularly in October, the monsoon flood seeps into the soil. Agriculture is very closely linked with these annual flood timings. Bangladesh has three main variants of rice; Aus, Aman, and Boro. Aus is harvested in the pre-monsoon dry season (July – August), Aman is harvested in the monsoon season when the lands are wet (November – December), and Boro is harvested in post-monsoon season (April – May). This variety of rice and the volume of rice production is also influenced by the increasing number of shallow tube wells and the high-yield variety in post-monsoon season in Bangladesh (Reardon, 2012).

Furthermore, the high-yield rice increased production from 10% in 1967 to 61% in 2008. This rise in production also increased paddy yield from 1.8 tons per hector (1990) to 3 tons per hector in 2008. Although the land used for rice production has not changed in recent years, the output of rice production increased from 15 million tons in 1990 to 30 million tons in 2008. The multiple seasonal harvesting also directly

reduced the price volatility of rice in Bangladesh, and the underlying motives for the adoption of high-yield variety rice by the rice farmers is the smaller maturity period, good grain quality and high yield (Reardon, 2012).

During the 'production process' of the rice supply-chain, farmers are engaged to the cultivation and pre-harvesting activities. These activities include pest management, irrigation management and seeking technical advice. During this process, the farmers communicate with government agencies, fertilizer suppliers and pesticide suppliers etc. This communication results in purchasing fertilizer, pesticide and seeking government extension agents to visit farmer's fields for inspection. The third and final process of the supply-chain includes harvesting and post-harvest activities such as transportation, storage, processing and marketing. The communication at this stage includes transporters, wholesalers, local buyers and city wholesalers, etc. The communication at this stage has different sets of outcomes by providing accurate timely market information remotely without visiting the market place (De Silva & Ratnadiwakara, 2008). Therefore, the supply chain process that leads to certain types of activities influences farmers to communicate with people relevant to their needs, resulting in certain benefits specific to the phase of production process that the farmers are engaged in.

However, mobile-led contact groups not only consists of contacts who communicate through the mobile phone alone. Some of the contacts also communicate physically. The farmers have some contacts who are mainly contacted through the mobile phone, and some are communicated with physically and some are communicated with both using the mobile phone and face-to-face. In this phase of choosing communication media, the 'unique features of the mobile phone' have influenced rural rice growers or the actor of the network (the discussion is presented in the following section). By using the mobile phone, the rural rice grower communicates with his or her social,

commercial and socio-commercial contacts. Social contacts consist of friends, families and members of the family who live abroad (Donner, 2008). The commercial contacts consist of the people such as wholesalers, seed-suppliers and local buyers, etc. The socio-commercial contacts are those friends or family members who have mutual commercial interest with the rural rice producers. Based on the discussions, the interlinked nature of the rice producers' activities, networks and mobile communication is conceptually displayed in figure 2.5.

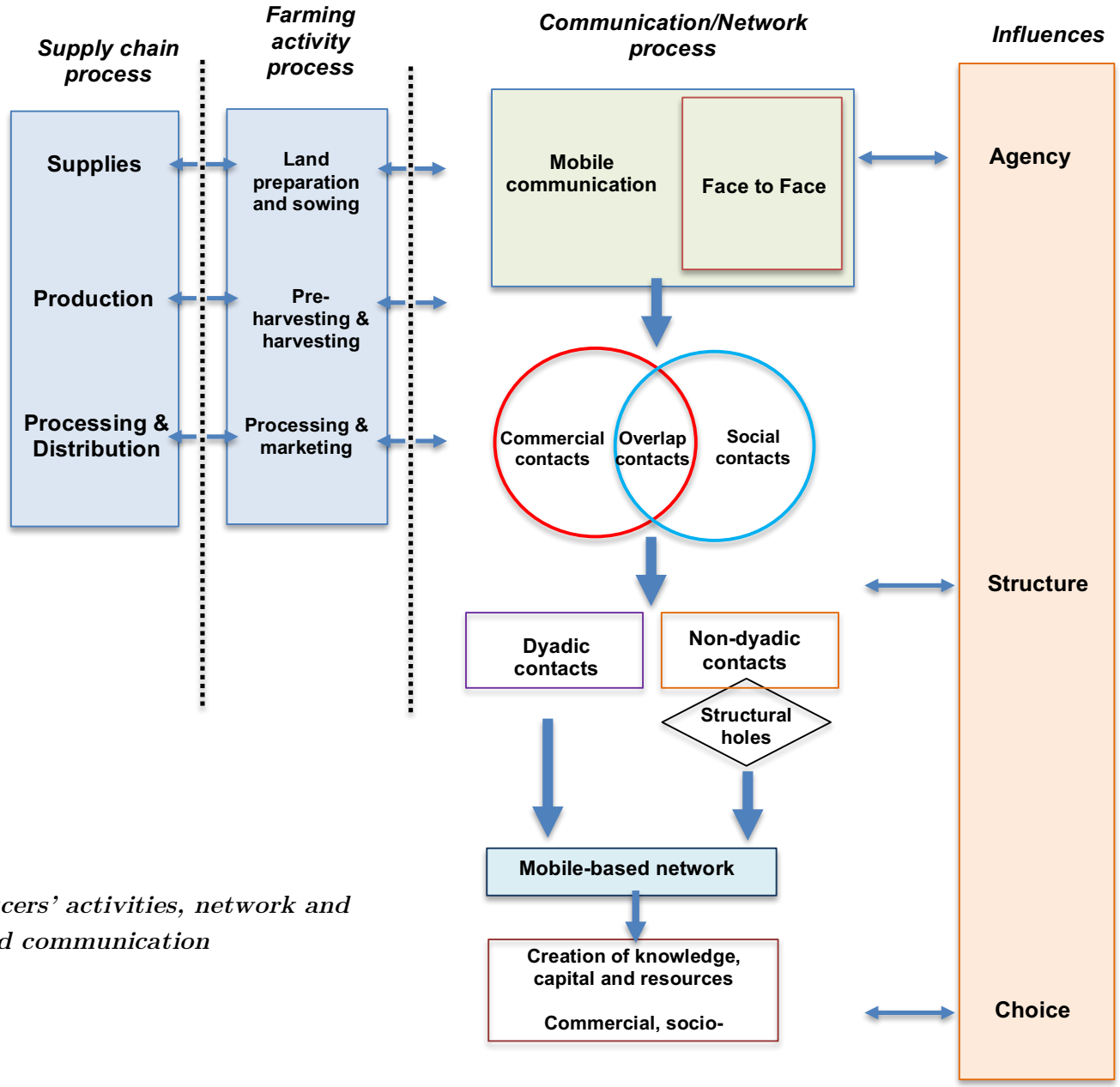


Figure 2.5 - Rice producers' activities, network and mobile based communication

2.6 Chapter Summary

The chapter started with a broader discussion on Information Communication Technology within the context of developing countries. The discussion is divided into three different segments. The first segment discussed the use of technology in rural areas, and highlights the importance of mobile based applications and the communication process from a general point of view. The following section discussed networks and rural SMEs, elaborating on the nature of the networks and how mobile phones creates the networks for the SMEs. The definition of SMEs and their commercial interlinks are also discussed in this section. The third section discusses Information and Communication Technology in rural areas of Bangladesh along with the key commercial activities of the rice producers. The section also covers the discussions related to the rice farmers' supply chain, input prices, land and the impact of seasonality on their communication.

3. Foundations & Framework

3.1 Introduction

The discussion of this chapter is divided into two sections. In the first segment, the research paradigm has been discussed. The paradigm explains the selection and emphases on the key theoretical foundations of the research. The discussion further explores the relationship between this viewpoint and the acknowledgment of the complex social phenomena underlying this research. The relationship between these perceived social phenomena dictates the philosophical standpoint for the research.

The ontology section explains how the researcher looks at the reality of this social phenomenon from a specific perspective. The theoretical foundations that have been utilized to explain the phenomenon have also been discussed in this section. The epistemological perspective in section 3.2 explains the knowledge that has been built on to explain this social phenomenon of the research. The discussion further elaborates on the theories that have been utilized for the research and how the philosophical viewpoint supports the outline of the theoretical framework of this research. The conceptual model discusses the theoretical elements onto and out of which the theoretical framework is constructed.

3.1.1 Complex Social Phenomenon and Research Paradigm

The way in which the literature review from the previous chapter relates to the research question and how the research objective will be achieved through the answers depends on the fundamental premise of the research paradigm. The scope and the nature of the enquiry dictates the researcher's perception of the social phenomena that influences the researcher paradigm.For example, the way in which the rice producers commercially benefit from using mobile phones is a ‘social phenomenon’. If the researcher considers the study of 'networks' as the primary focus of this phenomenon, then it shapes the research paradigm in a certain way. However, it is relevant to understand the way in which the study of the network is considered

to be the main focus in this phenomenon and the viewpoint of the researcher. Similarly, the meaning of how the farmers gain commercial leverage through using mobile phones is also an abstraction, or reduction of the whole process attached to the use of mobile phone by the farmers. Therefore, with the research question the researcher is essentially emphasizing a certain aspect of the whole social process.

In this case the phenomenon is reduced to analytical tractability by viewing the communication of the rice producers through mobile phones as 'network creation'. Although the mobile phone is a physical object, it is embedded within other elements of the surrounding contexts. Since the research is focused on how the device is utilised as a communication medium, this aspect of the network is considered as the key feature of the mobile phones by the farmers. This perception of the phenomenon is how the researcher depicts 'reality' in a certain way, this being the 'ontology' of the research. However, how the knowledge is associated with this perception of reality, and in particular, how the facts are discovered and interpreted is dependent on the philosophical assumptions of the researcher. These assumptions that constitute the conceptual paradigm associating perceptions of the phenomenon with the 'reality', point to the epistemology of the research.

The research paradigm, therefore, explains the basis for the different theories discussed in later section 3.2 (structuration, choice, resource-based view and networking) and their linkage with the social phenomenon that is intended to be explained. In the following section, the research paradigm is discussed in detail focusing on the ontology, epistemology and framework of the research (Guba, 1990).

3.1.2 The Research Problem; Epistemology, Ontology and Methodology

The social complexity of this research that has been presented earlier introduces the researcher's perspective of 'reality'. To understand and explain Bangladeshi farmers' mobile-based networks with their social or commercial contacts as a social phenomenon, the research introduces 'structuration theory' (section 3.2) .From the ontological perspective, the research

identifies the distinction between the farmers as agents and the social/commercial contacts as structure (the details of the ontology elaborate on the following section). Similarly, the other concepts such as social network and institutional theory (section 3.2) have been applied in the research related to the phenomenon, either directly or indirectly. For example, farmers use of mobile phones to create a 'social network' is directly connected to the phenomenon. 'Structuration theory' (section 3.2), on the other hand, is applied more in the form of a hypothesis from the researcher's perspective. These theories have been applied to explain the observed pattern of behaviour, or reality, to the diverse phenomena. Although this context can be seen as 'ontological fallacy' (Vygotssky, 1986) as it limits the way the research problem is viewed, this acknowledgment of the theories associated with the phenomenon specifies how the research will be conducted. The variety of theories and phenomena involved in understanding farmers' networking suggests that different methods and methodologies needs to be implemented to obtain the empirical findings for the enquiry. This way of applying the theories to understand a reality forms the ontological perspective of the researcher.

Karanasios (2014) shows that in ICTD (Information Communication Technology) research, the multidisciplinary nature of inquiry requires different theories for analytical purposes. Furthermore, the theories provide the knowledge that adds the generalizability to the research and provides the foundation for future work. Theories are used to explain phenomenon, and also enables the researchers to provide the critical explanations of the research subjects.

According to Smith (2006), ICT research is inclusive of literature that shows the straightforward causal relationship between technology and social outcomes. Such is not the case in this research, where the use of mobile phones is perceived as a communication medium that enable individuals to be able to create different types of networks that do not have a straightforward outcome for the users. Therefore, it is referring to something that is more complex in nature, than a linear relationship between the use of mobile phone by the farmers and a tangible outcome. According to Smith (2006), the causal explanation of the

phenomenon is the description of the mechanism that provides the condition and factors of the causal relationship. The implication of methodology is the key to explaining this causal relationship between the variables of the research, such as the use of mobile phones and the outcome of the use. Smith (2006) further mentions, that from the methodological perspective, when statistical methods are applied, the majority of the answers capture 'what' but do not answer 'how' and 'why.' Furthermore, the statistical techniques are reliant on a generalizable data size. On the contrary, the explanatory theories can be used in a few case studies. Therefore, to uncover their causal explanation for the research the role of the ontological and epistemological perspective of the researcher is important to be able to draw the methodological outline.

3.1.3 Ontological Perspective

The fundamental propositions of this research and the associated knowledge are reliant on how the researcher perceives 'reality'. From the ontological perspective, structuration theory has been applied to distinguish between farmers and their network. From the perspective of Giddens, ‘technology does nothing, except as implicated in the actions of human beings’ (Giddens and Pierson, 1998, pp 82). Following on from this point of view, the individuals’ interaction with society ultimately influence rules and resources, and is not impacted by the technology itself. Therefore, it does not change the agent's interactions with the structure. The transactional nature of the technology has been addressed by the perceived usefulness or benefit by the user, which in this case, is taken to be the commercial usefulness of mobile phones for the rice producers through the application of the technology to create and build networks. Thus, the research primarily considers how the farmers interacts with social and commercial contacts through the use of mobile phone and does not consider the interactions that exist beyond the mobile-based connectivity.

From the ontological perspective, the different theories have methodological significance. As perceived by Giddens, the structure and the agent exist only when they are interacting

(Cruickshank, 2007).Therefore, the structure exists through the amalgamation of the various interacting elements. In this research, the rice producers are interacting with two groups of people, the commercial network and social networks, which refer to the structure that the rice producers as agents interacts with. Here the structural properties indicate the commercial activities that the rice producers are involved with as result of their profession.

Rice producers, have some specific set of criteria to select the nodes in the network; for example, an input supplier is selected by the rice producers because of the nature of need that is expected by both the rice producer and the input supplier. Therefore, there is an inherent structural principle embedded in these interactions that are recursive. The rice producers continue to create such commercial and social network that is part of their role as agents (as a farmer and as social beings). Their interactions with the network are real and form structural properties, such as a relationship (friends or family) that enables the actor to create the communication ties. Similar to the commercial contacts, the rice producers' social contacts are based on the similar rules and resources of social common interest and capacity to inter-exchange. Therefore, the society the rice producers interact with, exists only as they interact. These rules of interaction from an ontological perspective are not different from how the rice producers actually practice communication because these laws reinterpret what occurs in reality: the rice producers communicating with social and commercial contacts (Cruickshank, 2007).

3.1.4 Ontology of Technology

Based on the work by Faulkner and Runde (2013), the identity of an object is determined by two considerations: function (the functional aspect of the technology) and form (the physical formation of the technology). According to the author, ontologically, the technological object is the use that people impose on it in pursuit of their specific interest. In this particular research, the mobile phone has been considered as a voice-to-voice communication device because of the existing literature on Information Communication Technology (discussed in

the literature review) which shows that the majority of the rural people in Bangladesh primarily use a mobile phone for voice-to-voice communication. The technological object has certain features or characteristics that are capable of performing the assigned function by the user (Faulkner & Runde, 2013). In this research rice producers use mobile phones to communicate with their social and commercial contacts because of the devices' potential in enabling the farmers to communicate anytime and anywhere as needed. The role of technology in human experience is instead shown by the way in which human experience - whether in some particular context or more generally – influences the use of technology. In either case, the role corresponds to a multifaceted relationship between humans, devices and the world. To understand the construction of this phenomenon, priority was given to a sociological understanding, rather than a solely device-centric, technological one. According to Dourish, (2004), "as we act through technology that has become ready-to-hand, the technology itself disappears from our immediate concerns" (Dourish 2004, pp 109). Therefore, the ontological position of the device with its specific functioning is the phenomenon of enabling the rice producers to communicate with a social/commercial group of people, where the unique features of the phone such as its capacity to be able to used 'anytime, anywhere' impacts their communication behaviour both knowingly and unknowingly.

3.1.5 Epistemological Perspective

Epistemology is the theory of knowledge that facilitates the understanding of reality (Blaikie, 2007). The literature review covered the necessary peripheries of the research starting with the farmer as an entrepreneur. The institutional settings such as the supply chain, with both formal and informal channels, have also been discussed earlier. The discussion in the literature review covered the forms of capital and the impact of information communication technology, and institutional practices. In conjunction, the livelihood framework is also discussed to provide an understanding of farmers' motivations to use mobile phones for commercial endeavours. Similarly, the choice framework presented by Kleine (2011) discussed in (section

3.4.1) and the empowerment framework (Alsop & Heinsohn, 2005) address the agency and its opportunity structure. The discussion of the livelihood approach and the empowerment framework that enables the individual to choose from the structuration point of view also provided the epistemological foundations of this research. From this perspective, the research intends to explain the relationships between farmers and their social and commercial contacts, which broadly speaking, make up the society around the rice producers. Therefore, this perception dictates how the methods for the research have been selected to understand and analyse the research problems (Walliman, 2005). The theories that have been selected to understand the interactions influence the epistemological approach. The objectives of this research focuses around the farmers' interaction through mobile telephony and the process through which different forms of capital and resources are associated with them. The farmers' choice to use mobile phones, and build their social and commercial network, and the commercial formal/informal supply-chain has an intricate relationship between the different theories. The recognition of these different social interactions between the actors forms the epistemological foundations of this research.

The literature and selected theories have been incorporated with the aim to answer the research questions, and defines the researcher's logic. This logic is primarily established through prior 'knowledge' in this particular field of study. Therefore, the origin of the epistemology for this research is vital to construct the solution of the research problem.

3.2 Theoretical Framework: Purpose and relation to the research

The theoretical framework is the referential map that provides all the theoretical components that interact with each other to produce the bigger picture of the situation that the research intends to analyse. The framework provides a standstill view that is required assess the continuous dynamic nature of rural rice producers' network creation process. This encompasses both the process of communication and the components that influence the network creations, explored in order to analyse their interrelationship. However, these

theories are not necessarily representative of the description of the components in the framework. The data collected for the research are given theoretical labels, and these labels are indicative of the interpretations of the data. Furthermore, the application of the theories is explained through the summarized outcome of the data. However, there are also interpretations associated with the data that indicate certain trends and patterns of the mobile phone use by the rice producers. Therefore, from a broad perspective, the framework requires an interlinked understanding of the components, either through case studies and survey data, in order to explain the pattern of the mobile phone use by the farmers. The theoretical components combined to construct the framework, where each of the components provide distinct meaning and explanations for the framework. The epistemological basis of the research provided the theoretical components of the framework and the ontology provides the foundation that segregate the farmer from its network.

The framework explains the process of communication exchange between the rice producers and their social and commercial contacts through the theoretical concepts that recognize the interrelations between the various components of the framework.

In the following section, the discussion has been divided into three segments, the background of the framework, the building blocks of the framework and the actual framework. The discussion also addresses the important elements of the framework such as choice theory, outcome, output and impact of ICT. The section also explains the different concepts related to the framework.

3.2.1 Background of the proposed theoretical model

This section provides the background of the theoretical framework of this research that has been inspired by some earlier literature. Information Communication Technologies and their interaction are considered using the choice framework originally proposed by Kleine (2010). The framework discusses several key aspects that are relevant to this research, such as the

personal attributes such as age, gender, and ethnicity which are indicative of the social context that impacts the resource portfolio of the individuals. The resources, in particular, have also been associated with the agency. The structure of this framework has been characterized by the institutional practices, and formal and informal laws of practices. The framework primarily emphasizes on the dimensions of choice to determine the outcome for the individuals. Choice has been shown as the principal outcome and the increased income, business ideas and other impacts have been discussed as secondary outcomes. The choice framework also includes TV, radio, telecentres and local libraries as the Information, Communication and Technology infrastructure. The framework brings the interactions between agency, structure and choice from a local Chilean community.

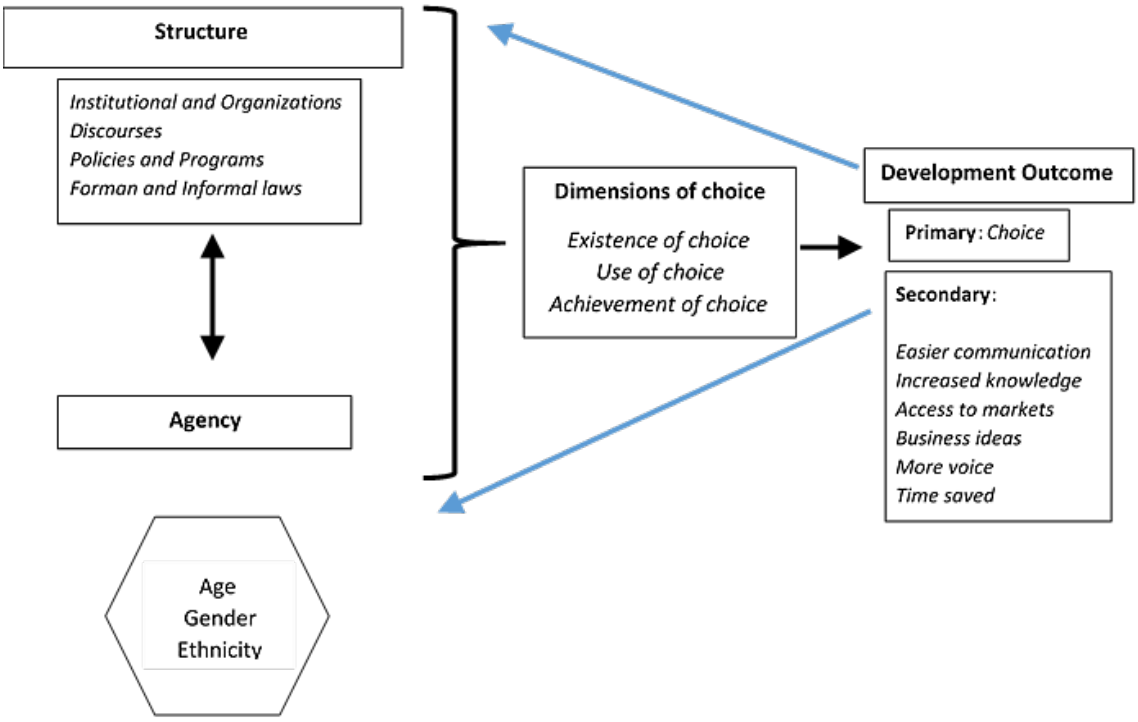


Figure 3.1- Choice framework- (Kleine, 2010)

Kleine's (2010) framework shows the improved choice to be the primary outcome for the participants using the telecentres. The example from the research shows how a Chilean woman use telecentre for virtual tour of Kaiserslautern, the place she wished visit in reality, but couldn't visit for financial reasons. This virtual tour given her the freedom that she desired. According to Kleine, this may raise a question of how it is related to the development

outcome, however from Sen's (2001, P:3) perspective development is referred to as “a process of expanding the real freedoms that people enjoy to lead the lives they have reason to value”. Kleine (2010) used this concept of individual's choice as what they value as a development outcome. From that perspective the Chilean women achieved freedom, as the end result through the choice framework, is the development outcome of using ICT.

As Kleine describes, the components of her framework are dependent on the theoretical background, and emphasis was placed on explaining the choice outcome through the use ICT. The incorporated framework defined the way in which the choice is linked with agency and structure. However, the focus of this thesis is different from that of Kleine (2010). Her research focuses on the choice outcome of using ICT from a broad perspective of mobile phones, telecentres, radio and TV. Furthermore, it is mentioned that there is a complex relationship between individual and collective choice that needs to be conceptualized carefully. In this research, the choice of the rice producers is not considered as an outcome. Instead, it is a component of the framework that provides the explanation for the rice producers’ use of mobile phones. Therefore, choice in this research provides a different meaning from Klein's' work.

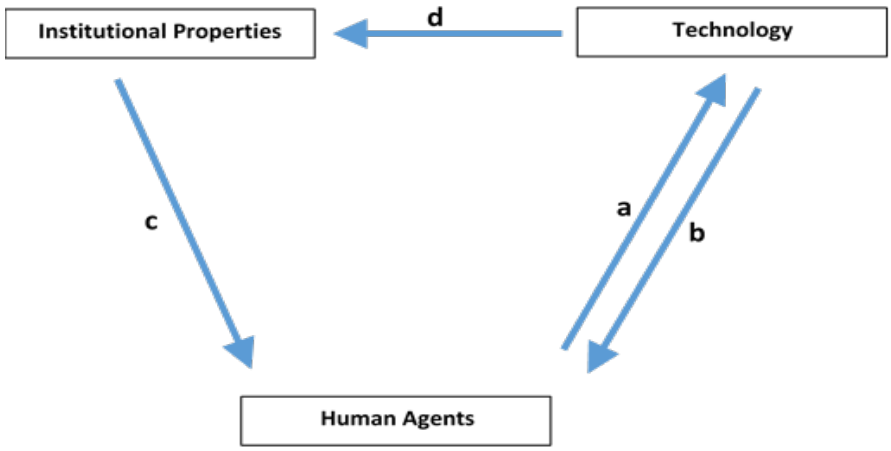
Mobile-based communication is primarily driven by farmers’ commercial or social needs within the agricultural supply chain. In the framework of this thesis, the interrelationship between the users’ ‘choice’ of the mobile phones and how this creates resources and network capacity will be discussed. The proposed framework utilizes choice theory in a manner similar to how it has been applied by Kleine (2010), where the interaction between choice, agency and structure has an interconnection. However, the actual choice order was adopted from the research presented by Alsop and Heinsohn (2005), where choices have been shown as the degree of empowerment.

According to Alsop and Heinsohn (2005) there are three degrees of choices: existence of choice, sense of choice and achievement of choices. The existence of choice is linked with the

passive/active diffusion of mobile phones. This diffusion is shown under the 'structure' in the framework. The availability of mobile phones in rural areas of developing countries is seen as 'passive diffusion' driven by "a combination of a private sector search for profits plus the poor's search for value" (Heeks, 2008, p.29). However, this diffusion is also caused by the fundamental limitation of fixed-line telephone connections to rural areas. Therefore, the diffusion was presented as active/passive diffusion and also influences the availability of 'choice' for individual farmers. This choice is dependent on the individual farmer's socio-economic influences. In this framework, the individual has been referred to as the agent using a composite measure of agency consisting of age, education and gender. These elements influence the choice and internal locus of control that influences their decisions (Côté & Schwartz, 2002). This agency has a simultaneous interaction with structure, which is mentioned by Archer (2003, p.130): "Reflexive deliberations constitute the mediatory process between "structure and agency", they represent the subjective element which is always in interplay with the causal powers of objective social forms". This interplay between the agency, choice and structure by using mobile phone creates different types of resource or capital, depending on its conversion factor (Sen, 1999). The interactions between the choice, agency and structure create different outcomes, outputs and impacts (the distinction between these three components has been discussed in the following section). The outcome, output and impact of using the mobile phone changes with different forms of capital and resources depending on the degree of choice and its interaction with the agency and the structure.

Orlikowski (2000) has written much on the role of technology at work. Her concern has been to explore the links between technology, social structures and behaviour, communication, and work practices. She introduces technology as an artefact that is dependent on the interaction of agency with structure. Following Gidden's approach (Giddens, 1984), Orlikowski considers resources and rules as part of structure, and she further explains how the human action or agency within a specific structural and cultural context and an objective set of rules creates and transforms the context (Orlikowski, 1992). Therefore, it indicates two important aspects

or influences: the objective set of rules and the structural context. These two aspects are better explained through the interrelationship between technology, institutional properties and the human agency as discussed in the framework. The objective set of rules is related to human action. This human action where the technology plays as a mediating factor dependent on how the technology has been perceived, the choice of the user and the utility assigned to the technology. The social and cultural context is the embedded factors that influence the user of the technology. Furthermore, it is shown how the institutional properties impact the human agents and technology, and has duality, where it is a product of human agency as the human create the technology as well as a mediating factor for the human when they use the technology. Especially, the dynamic nature of the structure is mentioned in her work, where the changing nature of the social practice evolving over time and space is explained.



a. **technology as a product of human agency**
b. **technology as a medium of human action**
c. **institutional conditions of interaction with technology**
d. **institutional consequences of interaction with technology**

Figure 3.2- Structure and ICT - (Orlikowski, 1992)

Along with cultural and social contexts, and an objective set of rules, the research of this thesis, also incorporates the influence of institutional influence and choice dimension by looking at the network created by the rice producers. The objective set of rules is the rice producers considering mobile phones as a voice to voice communication medium. The social

and cultural contexts of the mobile phone use by the rice farmer is dependent on the local practices or how the rice producers utilize the mobile phones to communicate. Therefore, the interplay between agency, structure and choice through the use of mobile phones has been interpreted, where the interactions with the social and commercial contacts by the farmers are always changing and dynamic. The following section provides three aspects of the framework that discuss the network, institutional environment and the choice dimension of the framework.

3.2.2 Building-blocks of the theoretical framework

Institutional aspect

From a farmers' perspective, the commercial and social contacts are part of the institutional ecosystem. Institutional theory discusses the norms, formal/informal practices and influences and impact of different institutions that are part of the organization - such as rice production for this research (Scott, 2013). Therefore, the culture of the rice producers is crucial for this research. The institutional environment that is referred to the theoretical framework mainly acknowledges the rules, practices and requirements of the rice producers to operate in the commercial realm. From the rice producer's perspective their commercial engagement, particularly their communication through mobile phone provides a reflection of institutional practices of the rice farmers. It is particularly useful to gauge how the rice producers perceive the commercial potentials in the communication. Their social communication is also vital in order to learn from an institutional perspective, and to explore the commercial significance of using institutional theory. The theoretical framework also discusses the various other theories that impact the rice producers and their communication with the social and commercial contacts. The framework consequently presents the linkage with the different forms of capital and resources. As discussed in the literature review section, the rice producers through the different processes can access the various forms of capital and resources. From an institutional theory perspective, there is the commercial practice in place that allows the

farmers to communicate, exchange and carry out the commercial activities that translate to different forms of capital or resource (Ransom, 1987). Therefore, in order to understand the extent and influence of these different social and commercial contacts on the rice producers, institutional theory has been adopted.

According to Ortmann & King (2006), from an agricultural perspective the institutional arrangement of the farmers is of two types. The vertical cooperation that includes the contract farming and the horizontal cooperation that include producer groups. Furthermore, these institutional arrangements have a cost implication for the smallholder farmers. The way in which these institutions are aligned for the rice producers' commercialization and how the commercial practices with the commercial contacts are conducted are all part of the institutional practices for the rice producers. In section 2.3.4, the supply chain of the farmers has been discussed. The different types of arrangements that exist within the rice production supply chain impact their commercial endeavour. The actors (faria, beparies, arothdar, retailers, city retailer and transporters) in the market system that has been discussed earlier (section 2.3.4) are the part of the institutional environment for the rice producers. The government extension agents and other government body are all part of the rice producers' institutional environment. This institutional arrangement is vital as perceive by Royer (1999: 49) because "Essentially, a firm should select the institutional arrangement that minimizes the sum of its production and transaction costs". Therefore, the rice producers' communication with these different groups of people has a financial motivation. Especially in the case of rice producers of Bangladesh, there is an institutional void that stresses the importance to use communication media to communicate with informal ties in order to conduct business.

The following diagram (Figure 3.3) shows farmers' social and commercial contacts that are part of the farmers' environment and includes elements of social/cultural context discussed earlier. The rice producers are considered as agents interacting with the social and commercial

contacts that represent their formal and informal supply chain. The peer communication between farmers is also an institutional practice for the rice producers. Therefore, the social and commercial contacts are part of the institutional environment for the rice producer.

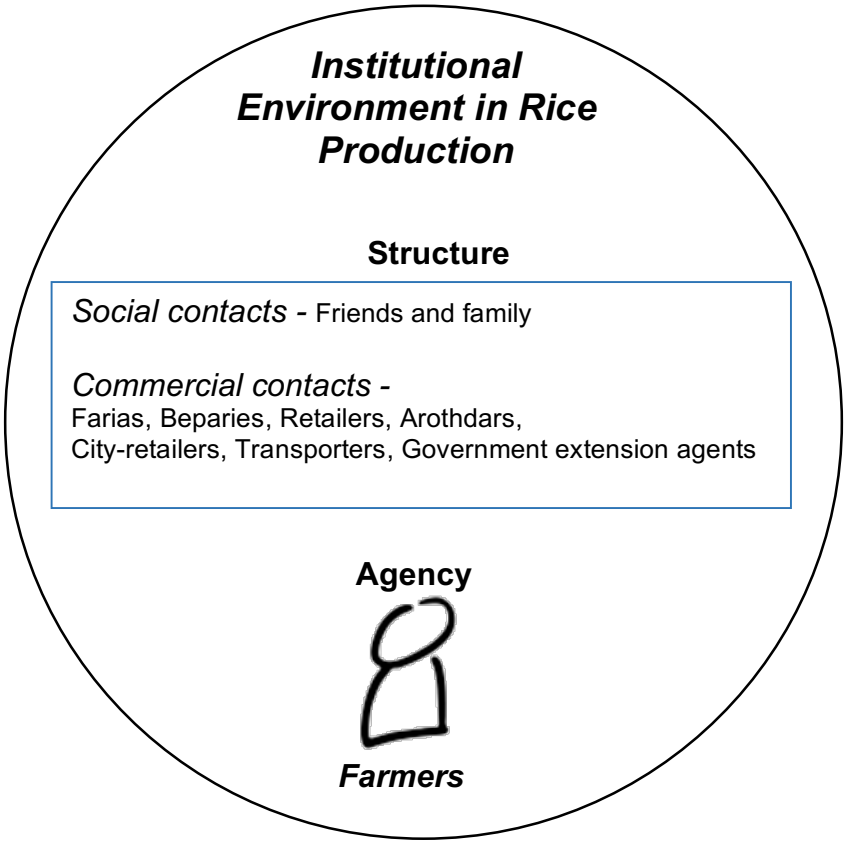


Figure 3.3- Institutional environment

Giddens' theory of structuration attempts to bridge the splits of actor and structure and claims that there is a necessity to learn social practices. Human 'agency' (e.g. farmers in the context of our study) is, thereby expressed through social systems (e.g. farming culture), beliefs, attitudes and identities. The concept of 'structure' used here is based on Kleine's framework (2009) where institutions and organisations are taken to be market actors such as wholesalers and suppliers in both formal and informal supply chains. Research conducted on women's empowerment by Kabeer (1999) has considered decision-making as a manifestation of agency, which can be measurable. Similarly, in the following section, agency has been considered in the form of having trust in the information acquired through mobile phones,

and the sense of relevance about the information received through the mobile phone. According to the fundamental proposition of Giddens, structure is not a particular external context, but rather the institutions or practices that are continually being modified by the interactions between agents. These continual interactions between structure and agent reconstruct the structure (Sewell Jr, 1992). Such a phenomenon in this research into the informal supply chain of the farmers has been created by the interactions between rice producer and the local buyers, city-sellers. The peer network between rice producers that benefit a rice producer, enabling him or her to gain relevant knowledge is also an institutional practice in the rice production business. According to Giddens, the process of structuration, therefore, incorporates both agency and structure (i.e. duality of structure) which interact with each other to 'structure' a society or social system (Whittington, 1992). Structure from that perspective is a medium of social practice/action that constitutes the system.

Farmers interacting with structure

The conceptualizations of the choice framework, structure and agency are useful for understanding the dynamics that shape the creation of resources for the rural rice growers. The level of choices influences output, outcome, and impact - which then change and create different forms of capital. The agency is also influenced by the structure, as discussed by Alsop and Heinsohn (2005). The example from India and Benin shows that the existence of formal and informal structure influences the opportunity available to the 'agents' as users (Alsop and Heinsohn, 2005). A rural rice producer understands by himself/herself what the interactions with the structure signify for his/her life. This is because it is the rural farmers who determine and agree to engage in the social or commercial exchange with an external feature of structure, such as a farmer's club or other means of accessing services from government agencies. These social and commercial relations are ultimately dependent on the shared meanings in mutual interest which the participants attach to their actions and relations. Following Giddens' structuration theory (1984), from a rural rice producer's

perspective, we can consider that the social structure that they live in is not only about the farmers - it creates its own norms that these individuals come to accept. Therefore, the influences of the society have an impact on the individual or the agency. Giddens' structuration theory functions by dividing between structure and agency, where these two different entities try to reconcile without falling into either objectivism or subjectivism. By that, it implies that an actor's interaction with the structure is capable of creating distinct 'value'. A farmer's communication with the government agency is materialized in receiving timely advice, which comes in a form of knowledge (De Silva & Ratnadiwakara, 2008).

The network aspect

The network of the farmers with their commercial or social contacts that the rice producers establish has both relational and structural dimensions. The relational aspect is about the types of relation that the rice producers establish with their network. There are distinct relation types that have been discussed in the literature review section (2.2.3). The structural aspect explains the type of the network the rice producer creates. The premise of this research is based on the use of mobile phones from a voice to voice communication perspective, since this is the major usage type of mobile phones among the rice producers in Bangladesh. The nature of the relationships also plays a vital role since the dyadic and non-dyadic relationships (section 2.2.1). Communication through the mobile phone usage of the farmers is a form of self-communication that was shown earlier (section 2.2.3) to not simply be a tool, but act as a medium that has elements of social construction. This medium is also linked with an individual's culture, behaviour and decision-making, and as a result the network types among these rice producers can also vary biased, based on their preferences.

The rice producers' mobile based contacts that include both commercial and social contacts is likely to increase their spatial promptness (section 2.2.3). The use of mobile phones also allows them to communicate with commercial contacts that live geographically at a distant location. The relationship nature with the commercial contacts not only provides the

alternative sources of valuable market information (mentioned in section 2.2.5) but also facilitate them with new market knowledge (explained in section 2.4.7). Therefore, the different types of networks and their relations in terms of frequency of communication is relevant for the research to be able to determine the type of network formed by the rice producers. Figure 3.4 shows, the network structure between the agent (farmers) and the structure (the social and commercial contacts).

Based on the discussion above, the rice producers' network characteristics such as dyad and multiplexity (section 2.2.1) explain the use of mobile phone for the commercial or social connectivity. A number of commercial contacts and social contacts the rice producers have significance that indicates their availability of sources for information.

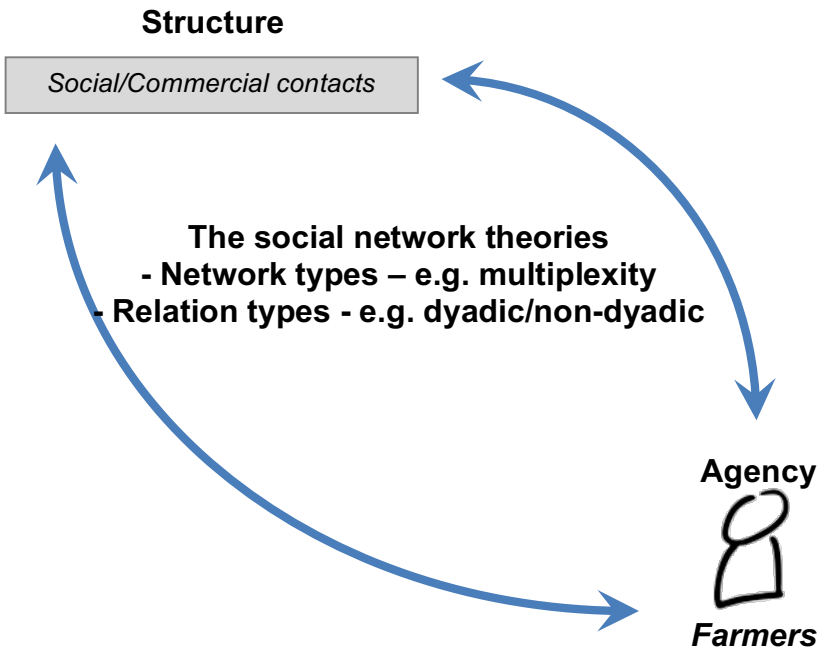


Figure 3.4- Network perspective

The successful relationship that creates a commercial success through a network indicates a 'bridging', a form of social capital (Putnam, 2000) that also creates 'commercial contacts' for the entrepreneurs. This may link people to distant acquaintances who move in different circles from their own and other 'structural holes' (Burt, 2002) between discrete groups of people

operating in separate social worlds (Section 2.2.9). Therefore, these relationships can be composed of friends and relatives or distant acquaintances. According to Valkokari & Helander (2007), the nature of the SMEs network is unclear as the network involves the individual's preference and is influenced by the personal relationships by the actor (section 2.2.9), as the actors who create these networks do not necessarily share common characteristics, such as the rice producer's commercial ties with a seed supplier. This network is created by the rice producers with either a strong or weak dyadic relationship. Therefore, the nature of this specific type of network that has professional links is different than just a social network that creates 'social capital' by building trust and confidence. This network, through the interactions between structure, agency and choice has the potential to form of capital and resources that benefits the rice producers along with their trust and long-term relationships with other actors with the same networks.

Tasavori et al (2015) show that the resource availability for the SMEs network can be perceived from an interdisciplinary understanding where the commercial exchange between actors (buying and selling) creates the firms and the market. With similar logic, the opportunity for farms exists because of the various actors in the exchange process. From an SME perspective, this indicates that it is not driven by the SME itself, but by the existing market, customers and suppliers who are active in the process. Reflecting on Latour's (2005) definition of agency, Tasavori et al (2015) shows how the agent is a subject of the embedded nature within the network of the SMEs. Through the networking perspective, the opportunities arise through the interactions of the actors. Therefore, the focus is not how the agency and structure interacts, but how they are configured. This perspective of opportunity allows the inclusion of social networks of the entrepreneurs (Tasavori et al, 2015).

According to Tasavori et al (2015), the creation of resources through the network has three stages; discovery, evaluation, and exploitation. Discovery is the constant interaction between the actors or the SMEs. Evaluation and exploitation refer to the new knowledge on the current state, which the actors either accept or reject. Exploitation also refers to the

collaborating actions of the actors. Actors' activities are dependent on their understanding of their own abilities and the opportunities that exist. The perceived existence of opportunity and resources are all socially formed and vary among different actors. This practice creates a feedback process by the actors where any mismatch between reality and their belief results in adjusting their beliefs and actions (Tasavori et al, 2015). The research also explains from a creation perspective that the opportunity does not inherently exist, but is generated by the actors. This means that the opportunities are not formed at the beginning, and the entire entrepreneurial conversion process should be taken into consideration, which unfolds how SME activities lead to the development of opportunities. Similarly, the same is applicable for SMEs, and their interaction with regards to the generation of opportunities.

The information through a network that has the potential to create opportunities for the actors is unevenly available across the network, and simultaneously the actor or the SME cannot process all the available information (Pahlberg & Persson, 2005). Furthermore, the depth of the relationship with the network determines the value of new information. According to Pahlberg & Persson (2005), weak ties in a network play an important role in providing new information for the actors, making these contacts important for obtaining new market information by both actors and SMEs. The intensity of their interactions determines close tie relationships which provide relevant information for the actors and their commercial networks. Subsequently, the level of dependency on the close ties for relevant information is indicative of their level of embeddedness in the commercial network. Pahlberg & Persson (2005). Ultimately, both weak and strong ties influence the level of embeddedness of actors and SMEs in the commercial networks.

Networking between actors indicates some type of relationship or inter-exchange. This relationship can be 'dyadic', (close family, friends etc.). In this particular research, the commercial connectivity between the rice producers and their social/commercial network will be explored where the frequent relation between actors indicates more sharing - therefore, a

valuable relationship. These relationship patterns also dictate the utilization of locally available resources. With less strong ties, despite more resources, actors may be less inclined to share with each other. However, a weak tie between the entrepreneurs with more people can also indicate connecting with people from different commercial circles. Therefore, there is access to more resources. According to Simmel, social structure refers to social interactivity between two or more people, where the nature of the network dictates the nature of their relationship in the network (Diani, 2000). However, rural entrepreneurs' mobile phone contacts might include both personal and professional networks, where understanding these networks is vital to this research. This is true especially in commercial networks, where the nature of the network or the type of bonding between individuals is vital for their business (Tundui & Tundui, 2013). These exchanges between individuals in a network increase confidence and cohesion (Coleman, 1990). However, the level of interrelation in a network is dependent on the type of network and the characteristics and defining elements of the 'actor' in the network. Social network analysis (SNA), such as in the mobile networks of rural entrepreneurs, requires information about the type of network where additional information, such as relationships (e.g., friendship, colleague, family) and the type of resources or activities between actors (e.g., information, money, materials), is taken into consideration. Depending on the types of network (weak/strong ties), the nature and pattern of information exchange between the social/commercial contacts differ. The strong ties or weak ties, whether it is commercial or social, potentially have a different level of importance in the farmer's communication exchange. In the research, the types of the network will be studied to assess the impact on the information exchange on the rice producers of Bangladesh.

Network and social capital

Research by McPherson, et al. (2001) hypothesized that social contacts and knowledge dynamically co-evolve, where the actors within a network exchange knowledge. This process of knowledge exchange further evolves through the interactions between actors, resulting in

a growth of communication among actors, both within a network and across other networks, which reduces communication costs and potentially increases relevant information flows. For farmers it reduces communication costs by reducing travel costs for marketing and negotiating. Being able to communicate through a mobile phone directly without traveling physically to communicate with any person, increases relevant information by being able to communicate more frequently with the relevant information providers (De Silva & Ratnadiwakara, 2008).The increase in mobile phone usage raises the level of communication among members of a social network and affects social learning, such that the rate of technology adoption is enhanced (Bandiera & Rasul, 2006). This new adoption also impacts new behaviour in the trading environment, such as the case where mobile phones provide better access to market information and farmers can call or text government agencies to ask for technical agricultural advice. This knowledge, created through the network, is the 'output' that brings changes in behaviour and practices of the user.

In this research, the network of rice growers has been observed, where these individuals' network ties represent a distinct personal community (Benjamin, 2001). From Putnam's research (Putnam, 2000), the impact of social network benefits individuals and the people who are linked within a network by creating `trust' that increases the exchange of information and communication that in turn leads to better coordination in the society. This coordination increases knowledge sharing in social, political, professional and other respects. Therefore, it results in a collective benefit, and hence creates 'social capital' for the actor in a network. This 'social capital' creates output in the form of knowledge, expert opinions and information through mobile phone usage.

3.2.3 The Choice Aspect

Within the network and the communication exchange between the rice producers and their commercial and social networks, there are institutional influences. In parallel, the 'choice' of the farmers also plays a vital role in the whole process of network creation and communication

exchange. The adoption of a mobile phone as a communication medium is also fundamentally a consequence of choice (Figure 3.5). Choice framework' as discussed earlier (section 2.4.3), provides an approach which explains how an individual with a set of options can interact as an agent with the structure. As the diffusion of mobile phones makes the technology more available in the rural areas, this availability from certain operators is part of a 'structure' that makes the mobile phones readily available for the individual. It is the individual's choice that enables them to decide whether they want to use the mobile phones to serve their commercial or social purposes.

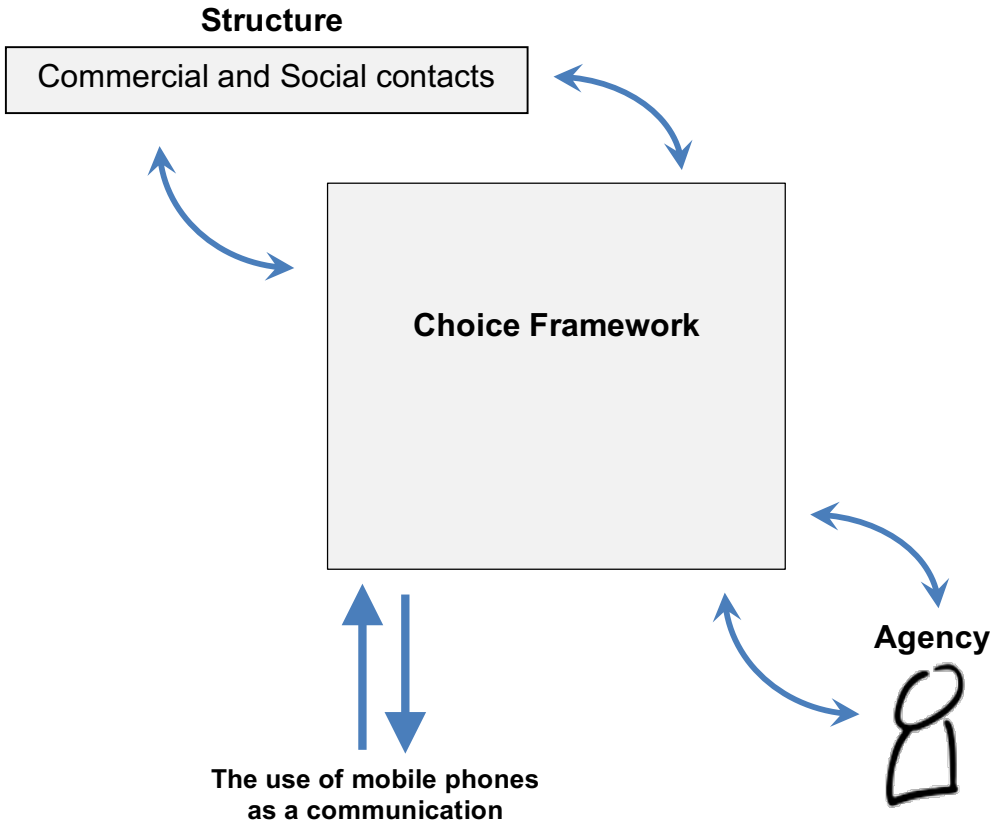


Figure 3.5- Choice perspective

An example provided by Alsop & Heinsohn (2005) shows a woman in Benin chose to send her daughter to school but her social surroundings - her husband and the school did not allow her because of the social inequality that exists in that society. According to Alsop, the woman's role as a mother could not fulfil the chosen decision to send her daughter school

despite there being no legal barrier. Furthermore, there lies a degree of empowerment, which can measure how the choice can be materialized. The three measures described by Alsop & Heinsohn (2005) are:

1. Availability of the opportunity to make the choice.
2. Use of the opportunity to choose.
3. Exercising the choice, whether the desired outcome is materialized.

Sen (1999) has elaborated this sense of 'capability' in his discussions on 'choice', particularly in his literature on development. Sen presented this 'choice' from various social dimensions: individual, social and economic. Sen argues, as an individual, it is one's freedom to be or do (hence, functioning as an individual) as each value. This 'functioning', according to Sen, is related is his or her 'capability' to act freely as the individual choses. Sen's approach has been utilized in Kleine's choice framework (2010), where the 'freedom' to choose has been shown as the primary development outcome. In the conceptual framework of this research, the 'degree of development', as shown by Alsop and Heinsohn (2005) has been adopted, which also takes into consideration of the interaction between agency and structure, as shown by Kleine (2010).

Applying the choice framework from the rice producers' perspective, the opportunity to exercise the choice and the materialization of the desired outcome by the farmers can be understood. The exercise of their choice is explainable through the use of mobile phones to communicate with social and commercial contacts. The desired outcome of their choice is linked with the actual benefit the rice producers gain by using the mobile phone. The materialization of the outcome can also be linked with the various other outcomes such as the commercial nature of their mobile phone use. Similarly, with mobile phones at their disposal, it is the rural rice grower's 'exercise of choice' that allows him or her to call government agencies for any support or assistance. Therefore, there is a linkage between the

agency, structure and choice that determines the outcomes of the usage of mobile phones as a communication medium. Furthermore, the livelihood impact, also falls within the domain of this mobile phone usage.

3.2.4 Theoretical Framework

According to Heeks (1999), there is a separation between technological determinism and social determinism. The technological determinism emphasizes the inherent technological elements that impacts ICT. On the other hand, social determinism considers that the human choice within the social structures determining the impact of ICT. Heeks emphasizes the necessity for a framework to simplify the complex reality to understand the differing positions on impact. However, from the previous section, the interrelated nature of agency, choice and structure have been observed. The technology feature, such as the unique features of the mobile phone in this research, is also an impact of the agency. The fundamental objective of a social or technology determinist relating to the impact is to understand the linkage with any form of capital or resource and the use of technology. Despite the varying motives of using mobile phones, receiving information through the medium is the immediate outcome. This information can be described as a form of resource since it is vital for the knowledge creation and decision-making process (Evans, et al., 1993). However, the fundamental difference with other sources of media and the mobile phone is in the features of the technology that interact with the agency (preference, decision, etc.) and structure (formal/informal supply chain channels), allowing an individual to reflect his/her choice. This ability to exercise choice on the other hand is related to accessing resources. Therefore, the societal configuration that makes the resources available is also influenced by the individual's actions regarding the rules and regulations that make up the structure. There is a complex relationship that is reflected by this adoption of the mobile phones by the farmers. The information that creates knowledge for the farmers also transforms the knowledge to decisions related to their rice production. Among the actors, the information helps to create the knowledge.

The farmers in the study have exercised their freedom to use the mobile phones in order to be able to communicate with the selected buyers and suppliers to receive information. The actual process of accessing the information requires the farmer to be actively involved in selecting the 'trustworthy' sources, to be able to accept the information and convert to knowledge. However, the usage of the information varies from farmer to farmer. The network that makes the resources available to the farmer is not the social structure itself. Agricultural academia tends to generalize farmers into one single group (Morris & Evans, 2004). However, research by Poole et al. (2013) shows the importance of understanding this heterogeneity of farmers from a policy perspective. The research emphasizes the understanding of the context and intersubjective knowledge relating to understanding the smallholder farmers. This heterogeneity influences the farmers regarding how they create their social/commercial network. Some commercial contacts are common among the farmers, which is indicative of the farmers as agents interacting with the structure (the local wholesaler, buyer etc.). The interrelationship and the resource availability differs between the individuals. The use of technology, as an artefact (Orlikowski & Scott, 2008), such as mobile phones allowing farmers to interact with the commercial/social contacts that have the potential to communicate with social and commercial contacts (structure) is determined by the recurrent use of technology (Orlikowski & Scott, 2008).

Given the ubiquitous nature of the mobile phones for sending and receiving calls, it can be expected that the impact of mobile telephony will be making phone conversations more similar to offline face-to-face communication, which creates 'social capital' for the users among a closed tie network (Burt, 2002). Separate research by Resnick (2002) considers that the mobile phone user's usage is a combination of social network and information technologies in the form of 'socio-technical' capital. The rice producers owning mobile phone to communicate with the social and commercial contacts indicates the existence of the capital. As the author mentioned, there is a social relationship that plays a vital role on how the mobile phone is being utilized. Here, the mobile phone in itself is a technology that has an influence on its

features on user's preference and communication. Therefore, there is a complex social and technical arrangement takes place when the farmers own and use mobile phones. This social-technical arrangement is the circumstance where the influence of choice, structure, and theory intersects. From the literature review, it was apparent that despite having any specific financial or non-financial benefit, the farmers consider mobile phones to be useful. This 'usefulness' very specifically indicates towards the socio-technical arrangement that the farmers created by having social and commercial contacts whom he/she can communicate with, irrespective of any financial or non-financial benefit. The source of this resource is the interactions between the choice of the farmers to use a mobile phone in order to communicate with his/her social and commercial contacts. The complex interactions also reflect on the two essential elements, the sociocultural context and objective set of rules that have been discussed in an earlier section (Section 3.4.1). The framework in the following diagram 'problematizes' these two elements by creating two dimensions, the structural dimension and agential dimension, which are discussed later. These two dimensions have incorporated the three aspects of institutional impact, choice, and network.

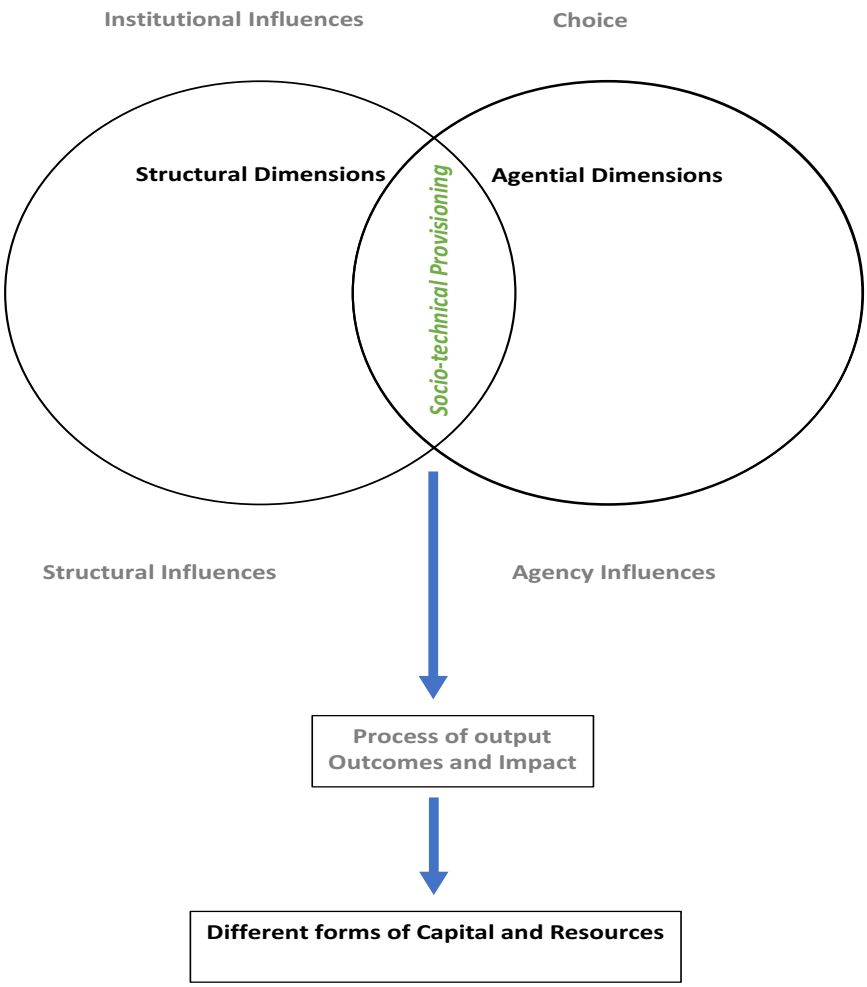


Figure 3.6- Theoretical framework

This particular form of the resource is created within the commercial network of the agricultural supply chain, where choice, agency and rice growers' networks interact. These forms of capital/resources interchange with other forms of capital and resources based on the use of mobile phones. If the actor is restricted to social communication exchange using a mobile phone, it creates the social bonding resulting in 'social capital'. Their number of social contacts and their nature of communication using mobile phone is indicative of the social capital.

However, when this network is utilized for entrepreneurial communication exchange, it creates 'entrepreneurial capital' (Firkin, 2001). This characteristic of convertibility means that resources that have been created by the rice producer can, depending on circumstances,

be converted into an entrepreneurial purpose or advantage. According to Firkin (2001), a person has various aspects of his capital linked with the entrepreneurial process. Such as their desired to be a self-employed or prior experience. These attributes are also linked with the human capital. Furthermore, this small set of components within the human capital that is related to the entrepreneurial domain is also related to the economic capital of the individual. In these independent elements when examined separately, they create the entrepreneurial capital based on the resources they are attached to. Applying this concept in the research, it can be discussed in the light of the social, commercial network and the individuals' entrepreneurial experience (human capital). Those parts, which can be converted, possess varying degrees of entrepreneurial value – for instance, some are financial, intangible like commercial values, and others.

The rice producers communicating with commercial contacts and using the mobile phones for commercial transactions indicates their use of mobile phone for commercial purposes. The rice producers' perception of timeliness, importance, and relevance are the attributes that they associate with the use of mobile phones. Their different uses along with their different sets of commercial and social contacts create and recreate a different financial and social emphasis. This emphasis and preference are attached to the various forms of resources.

The substitution, enhancement, exchange and disembodiment of the different forms of resources or capital realized through this sociotechnical provisioning state, (section 6.1.3) as long as the user continues to use the mobile phone for commercial, socio-commercial exertion. Therefore, it is this state that allows the farmers to transform different forms of capital or resources that exchanges to different forms of assets.

3.2.5 Structural dimension

The rice producers as the agent are very closely tied to the local practices and norms. Their social and commercial interactions with their peer farmers, local traders, input sellers and buyers creates the commercial ecosystem that these rice producers are part of. Therefore,

their access to local resources and opportunities is dependent on the local embeddedness that the rice producer is part of. According to Granovetter (1985), the embeddedness is an economic behaviour that exists in premarket societies that became autonomous with modernization. Furthermore, the embeddedness creates the social influences that the actor acquires customs and habit and emphasises on the trust over the relation and structure. Therefore, embeddedness is founded on the social relationships for economic activities.

The embeddedness here comprises the local knowledge, connections, culture and practices that the rice producers needs to adopt (Anderson, et al., 2007). The rice producers' trade-related activities are also deeply connected with the local practices, which is also the limitation that the rice producers face as it does not allow any deviation from the existing structural practices of rice production. So the rice producers are socially embedded in such a way that the configurations of the institutional practices dictate how the farmers will have the access to different forms of resources despite the adoption of new technology having greater possibility than the existing practices. This regulating structure enables the farmers to access to the 'social capital' that has been discussed in the literature review (Chapter 2 section 2.2.5). This social embeddedness is the prerequisite for the social capital that comprises the social/commercial contacts that enables access to resources for the rice producers. This embeddedness in this research has been identified as the structural dimension of the rice producers.

Therefore, the institutional practices, the creation of social capital and availability of choice are all interrelated and dependent on the influence of social embeddedness of the rice producers. Since as an agent the farmers' commercial understanding and spontaneity are also influenced by the nature of social embeddedness, this impacts their behavioural aspect as well.

3.2.6 Agential dimension

The agential dimension in this research indicates the notion of the individual farmer's interaction with their social contacts using technology. The influence of the society and how the farmers reflect and operate based on these interactions is dependent on the self-reference (Luhmann, 1993). Therefore, the external dimensions of the processes such as the influence of the society, the rules and norms are part of the farmers themselves. In socio-technical literature this dimension has been referred to as stakeholders (Walsham, 1997). The rice producers adopting mobile telephony and using the technology for commercial or social purposes makes the use of technology not only an artefact, but a device that consists of both social and technical elements (Kling & Scacchi, 1982). The stakeholder dimension is influenced by the structural dimension (socially embedded nature) of the rice producer as it is shown in the previous section. The cognitive dimension particularly the decision-making process for the farmers is determined by the social perception (Walsh, 1995). Therefore, the choice of mobile phones and the embedded nature of the rice producers influence one other. Farmers do not use the mobile phones only for their commercial needs, they also use the mobile phones for ordinary communication needs. Agency influences, such as age, education and related social indicators reflect the agency dimension of the rice producers. The choice of how to use a mobile phone for communication is also influenced by these indicators. Therefore, the holistic nature of the information exchange varies depending on how the farmers as socially embedded agents perceive and assign meaning to the use of mobile phones as a communication medium. Therefore, it is the agential dimension that determines the possible use for the commercial benefit of the rice producers.

3.2.7 Socio-technical provisioning

The agency and structure notion in this research provided interdependence and independence between the rice producers and the network created by them. The two dimensions described earlier – agential and structural, both influence the rice producers to be able to create any

form of resource or capital. From the structural perspective, the commercial decision of a rice producer is influenced by the social/commercial contacts, institutional and cultural influences. This context that has been created is fundamental to the economic outcome for the rice producers. Agential perspective discussed the use of mobile phones for the rice producers to be able to communicate with the social and commercial contacts. Their use of mobile phones is also influenced by the unique features of the mobile phones, perception of use and social practices. The outcome, output and impact of using the mobile phone are therefore determined by the structural and the agential dimensions of the rice producers. This intersection between structural and agential dimensions create what is referred as socio-technical provisioning, and includes both agential and structural aspects. The notion of provisioning from a broad economic perspective can be explained as a process through which goods and services of society are organized by the social condition and structure that includes the class, culture, power, politics and environment (Jo, 2011). This research, however, focuses on the microcosm of the broader perspective that creates the unification of these two factors (agential and structural dimensions) together. The agential aspect signifies the individual rice producers' motivation and effort to use the mobile phones to engage in commercial activities, and the structural aspect implies the commercial/social contacts and the commercial/social communication exchange of the rice producers. However, the capital or resource that the rice producer will be able to create is dependent on the intersection of these two influences. This scope that has the potential for different types of capital or resources is the socio-technical provisioning for these rice producers.

3.2.8 The conversion of different forms of capital and resources

The 'conversion factor', which is utilized in this framework, was proposed by Sen (1999). This conversion factor converts the marketable/non-marketable commodities to the 'functioning' of the resources. Here, in this research, the mobile phone has been considered to be the prime communication medium that has been utilized to create the resources. The way in which the resource has been utilized will change the different functioning for the users; therefore, the

outcome, output and impact change. The conversion factor thus indicates how much functioning the users can get out of the use of the mobile phones. Different types of conversion factors have been discussed in the recent literature (Robeyns, 2005). There are discussions about personal conversion factors, social conversion factors and environmental factors. The personal conversion factor and social factors in this research are linked with 'agency', where the individual's education and age (personal conversion factors) and gender and race (social conversion factors) influence the individual's choice hierarchy and therefore causes it to convert in different levels of outcome, output and impact for the farmers. In this framework, the socio-technical provisioning indicates a complex relationship between the society, resources and the rice producer. For example, a rice producer may swiftly obtain information from a government agency through mobile communication and the efficiency of information exchange can be measured. However, access to information through a farmers' club is difficult to measure, because how useful the information for the rice producer is dependent on the individual farmers' needs. Similarly, a recently joined member of the local farmers' club might not get enough relevant commercial knowledge immediately. As the club meeting takes place at regular intervals, the new member who did not benefit from prior membership of the club will begin to receive the benefit after attending some meetings, as this benefit is a cumulative process. The choice framework, in this regard, increases another layer of complexity, since it represents a varying level of choice among the individual that interplays with the agency. The fundamental challenge of utilizing the capability approach (Sen, 1999) in this research was to bring the complex relationship between choice theory and agency-structure model, which is linked with the provisioning state.

The evaluation of output, outcome and the impact of using the mobile phones varies according to their inter-relationship with the degree of choice and influence of agency/structure in this synergistic framework. Before the information is transformed into knowledge for the farmer, the contact that has been created through the mobile phone is also significant for the user. The provisioning state that has been introduced in this framework

explains the social and technical condition for the rice producer. Once the farmer establishes a good number of contacts for receiving information, the farmer creates further social and commercial capital. This capital is based on mutual trust, and creates a basis for learning and knowledge transfer across the exchange interface, and it can also curb the opportunistic behaviour. The knowledge that has been created and utilized for the trade is transformed into 'entrepreneurial' capital. Therefore, the socio-technical provisioning that is an intersect between the structural dimension and the agential dimension impact the resource creation by the rice producers.

The rice producers communicating with their social contacts using mobile phones creates social capital. When these social contacts are communicated for any financial or commercial purposes, the phones become a device that facilitates the acquisition of financial resources. If long-term, frequent communication is established, enabling continuous mediation between the contacts, this makes the mobile phones a commercial resource, thereby indicating a conversion of the resource from social to commercial capital. The use of mobile phone therefore enables the process of creating and recreating different forms of capital and resources, and based on their pattern of use the resources conversion takes place.

Mobile phone usage has been discussed in various economic discourses regarding its interaction with various types of resources or capital. The term 'network capital', used by Wellman & Frank (2001) refers to a particular type of social capital that makes resources accessible through interpersonal relations through the use of mobile phones. However, the benefit of mobile phone usage is not restricted to this availability of resources alone. For the rural entrepreneurs, a lack of technical skill is one of the biggest constraints. Field research by Heeks and Duncombe (1999, 2002) shows that the usage of the mobile phone improves information handling skills such as interpersonal communication and business efficiency, which directly benefits the user. Therefore, adopting mobile phones creates a form of 'human capital' for the entrepreneurs by developing their commercial technical skills. This creation

of 'human capital' affects the agency and its interaction with the choice framework, where the individual chooses to learn the commercial skill that alters the 'output' and benefits of mobile phone usage for enhancing livelihood strategies, in this case of Bangladeshi rice farmers. This will be referred to as 'commercial capital'. Monge, et al., (2008) show that the traders benefit from network creation, and that a network has the capacity to build 'trust' among the actors to exchange information and facilitate credit. Since a mobile phone is considered as a medium that facilitates dyadic network (discussed earlier), it is potentially creating 'financial capital' for the actors. For credit facilities, rural rice producers communicate with the available lending agencies. These interactions bring agency to interact with structure (the credit authority), where choice plays a vital role for the farmers to choose the pattern of mobile phone usage. Considering that voice-to-voice communication is the main use of the mobile phone, rural rice producers benefit from accessing information and thus the applications of ICT through improved communication of information expand market boundaries (Aker & Mbiti, 2010). Mobile phone usage has been discussed for its capacity to facilitate co-ordination, which can create 'social capital' for the users. Applying the uses and gratifications theory, Leung and Wei (2000) argued that major motives for mobile phone usage are fashion and status, because the phone provides a means of symbolic expression of social identity. Therefore, mobile phone use is capable of creating various types of resources or capital formation that enhances poor people's opportunities and strengthens their voices. This is attained when poor people access relevant information that improves their livelihoods (Cecchini & Scott, 2003). These various types of capital or resources are created by the interactions between agency, structure and choice. This interaction creates different forms of output, outcome and impact for the farmers resulting in different resources.

3.2.9 Resources linked with farmers' livelihood

Small-scale farmers' entrepreneurial progress is linked with their livelihood strategies, as they are exposed to various socio-economic adversities (Dorward, et al., 2009). In addition to their

economic vulnerability, the agricultural market inefficiency adversely affects small farmers in rural areas. Recent research has shown how information and communication technology plays a vital role both in rural people's livelihoods and asset creation, where market imperfections adversely affect rural farmers (Salia, et al., 2011). Similarly, another study by Mittal (2012) showed how mobile phones benefited farmers by reducing the price dispersions of produce, enabling farmers to cope with the financial shocks. To understand the actual process of communication that leads to financial or non-financial benefit for the farmers, it is important to understand what drives the farmers to adopt specific communication media.

Social capital is one form of capital from the sustainable livelihood approach. This will be discussed in the following section as an analytical tool that provides a better understanding of the context of poverty (Chambers & Conway, 1992). The sustainable livelihood framework is very useful for understanding how poor households utilize different forms of assets to deal with vulnerabilities and choose strategies to attain successful livelihood outcomes (Ashley & Carney, 1999;Donovan & Poole, 2013).

Recent research by Makoza (2014) on Malawi microenterprises adopted this model of SLA to study the impact of ICT on SME's livelihoods (Duncombe, 2006). The model adopted by the researcher emphasized the two distinct roles of ICT in a livelihood; one is the analytical role, which allows ICT to be utilized to assess the extent of vulnerabilities, measure assets and investigate structures and processes to better cope and adopt livelihood strategies. The functional role of ICT, on the other hand, applies for households and SMEs and identifies and analyses the actions that create constructive livelihood outcomes. The different assets forms described by Duncombe (2006) are as follows:

- Human capital: skills, education, health etc.
- Social capital: social relationships and networks, trust and bond between individuals
- Natural capital: natural resources, stocks of produced goods
- Financial capital: money, income and credit facilities

- Physical capital: infrastructure, land, physical properties

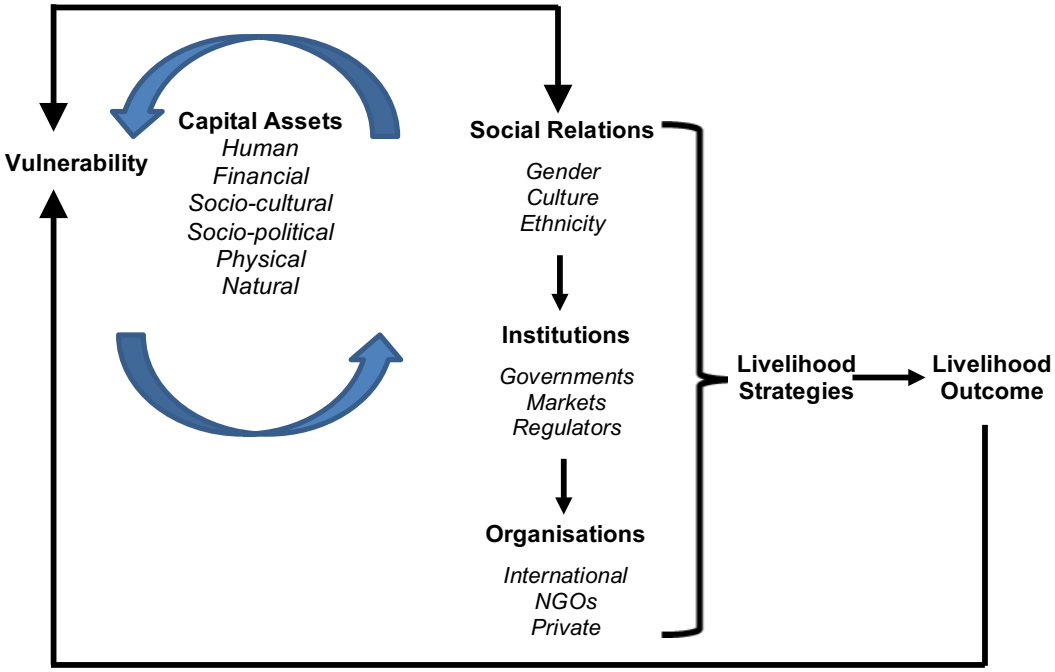


Figure 3.7- ICT's role in livelihood (Duncombe, 2006)

Carney described livelihood strategies as the actions carried out by individuals to deal with vulnerabilities in livelihoods (Carney, 1999). Duncombe's (2006) research on women enterprises in Botswana showed how the application of ICT impacts poverty reduction. Another study by Soriano (2007) showed that this relationship of ICT to livelihoods is linked through access to information and knowledge that impacts the reduction of poverty. In these discussions, livelihood outcomes were conceptualized by utilizing assets impacted by the role of information and ICT by reducing the vulnerabilities of SMEs. In the following section, the discussion will further progress by examining ICT's role through mobile-based networks and by focusing on the nature of relationship, whereby it can be argued there is a potential for creation of 'commercial capital' for these rural SMEs.

The farmers use a different mode of communication to be able to access information and this has a direct relationship to their livelihood strategy. "The dynamic aspirations of poor people;

of diversity between different people adopting different strategies, and of diversification by people undertaking a variety of activities, as they mix their strategies in pursuit of those activities" (Dorward et al, 2009: pp.243). According to the authors, there are three complementary processes of the livelihood strategies, the first process is to sustain the existing livelihood, the second strategy is to increase productivity and third is to move on to different new activities. So, the motive for using a mobile phone for these farmers varies, based on the priority of the farmer and how he/she utilizes the phone for his/her livelihood strategy. The use of mobile phones varies between farmers; the use of mobile telephony results in a complex interchange among the actors in the rural SME network (Van Biljon et al, 2008).

Early communication research shows that technology users choose a specific medium to fulfil their motives (Katz & Blumler, 1974). Here, the 'motive' of the rural farmers is dependent on the types of activities the farmers are involved in. These activities are tied with the particular phase of the supply chain. From the supply-chain perspective, the processes include procuring input supplies, production and marketing/distribution. In the first process, the activities of the farmers are related to the land preparation and sowing phase. In this phase, the farmers prepare their land for sowing selected seeds and engage in the activities to prepare the land. Therefore, they are driven by their need to communicate with the people who are involved in supplying the relevant seeds and fertilizers. The communication with these people eventually results in buying seeds, borrowing machinery, soil testing etc. These contact groups have distinct advantages for the rice producers; that varies at different stages of production. Such information related to farming technologies during the land preparation stage could play a vital role for the farmers (Cameron, 1999).

3.3.10 Process of resource creation

Resource based view of the entrepreneur or firm refers to the combination of resources that provide competitive advantage (Das & Teng, 2000). The resource-based view economics

literature is also associated with capability. In this thesis the rice producers who use the mobile phone to communicate with their social and commercial contacts are utilizing this medium for commercial and non-commercial objectives. The underlying motivation for this choice is vital for this research. While utilizing the mobile phone for commercial use, whether the rice producers view this as the resource or 'capability' as commercially beneficial is central issue for the research question.

In the literature review section, the difference in intangible/tangible resources has been explained. The intangible resource for the farmers includes the commercial network and information commercial agreement. Whether the rice producers considered this use of mobile phone to be commercially advantageous or not will determine if a mobile phone, from the resource-based view, adds value to their commercialization. The resource view is not entirely about rice producers' perception as a resource - it is also about their capability.

The social capital primarily discussed in the literature review to depict the social connectivity of the rice producers. This form of capital is important to discuss from a network building aspect where the rice farmers create contacts with the other farmers. This type of capital is distinct from the commercial capital that includes the network of the rice farmers with the commercial contacts. The resource-based view discusses the rice producers' perspective of how the mobile phone is perceived as a commercial resource. To explore the resource based view, the farmers' use of mobile phone for commercial purposes has been investigated through the case study and survey approach. The rice producers' perception of mobile phone as a resource is also a considered as a form of commercial capital for the rice produce. Human capital on the other hand add values to the farmers by adding agricultural or professional skills, that is possible through the knowledge exchange through social/commercial contacts. In this research, the knowledge exchange through the commercial or social network depending on the content is considered as multiple resource or capital where the knowledge exchange

from a social contact is a form of social capital that knowledge adding new knowledge provides the skill to the farmers to utilise in their agricultural productivity.

The choice framework that has been discussed earlier reflects on this theory from the rice producers' choice dimension. The 'choice' that has been discussed by Kleine as capability is a primary outcome. The farmers increased the opportunity to communicate to the commercial contacts - if perceived as a resource by the farmers, will indicate as possible input for their commercial production process. However, the farmers use the mobile phone as a communication device more often, so if it is utilized for their day-to-day commercial operations then it can add to farmers' operational capability.

Research by Zainudeen et al, (2011) showed that the use of mobile phones is predominantly perceived to be for social purposes. In this research, the data gathered from different regions of India and Sri Lanka shows that the primary usage for the mobile phone is family connectivity. Thus, there is an element of 'social cohesion' in mobile phone usage, which helps families to keep close connectivity; therefore, this connectivity through mobile phones is not just an exchange of social dialogues. Despite the debates concerning the actual benefit of ICT in the international development scenario, the question of 'if' ICT is instrumental now has moved to 'how' it is advantageous for developing countries (Walsham et al, 2007). The differences distinguished between outputs, outcomes and impacts, as proposed by Heeks (2010), were utilized in the proposed framework to be able to analyse 'how' the use of mobile phones positively affects rural farmers.

However, in this research, the 'impact' and outcome of the ICT adoption for the rural farmers has been seen from a 'social-embeddedness' perspective (Avgerou, 2010), where two different theoretical paradigms, network and agency-structure theory, have been considered. These two theories create a range of different impacts and outcomes for mobile users. The mobile phone as a technology that is used by the rice producers for communication is rooted in a

specific cultural context (Orlikowski et al, 2000). How the rice producers use the technology that benefits the user is dependent on the practices of the user; for example, a farmer's adoption of a mobile phone at various stages of their production cycle can be impacted by providing better market access and financial inclusion, depending on the mobile phone usage by the farmers.

The mobile phone as a communication medium also allows farmers to communicate with people from distant places beyond their face-to-face network group. Within these three types of contacts (social, commercial and socio-commercial), farmers form dyadic and non-dyadic ties that they communicate with during the three different supply-chain process phases. These dyadic or non-dyadic contacts may differ at the different production cycles. Consequently, a selected group of people have been chosen by the rice growers to form a 'mobile-led network' that consists of social, commercial and socio-commercial contacts.

These different phases of the network evolution are influenced by the structure, choice and agency (the detailed discussion has been presented in the following section). These influences determine how the mobile-led network takes shape. For example, a farmer receiving useful information and support from a government extension agency might create a dyadic relationship between the farmer and the extension agent. Here, the institutional support that exists in the form of government extension service benefitted the rural rice grower by providing vital information for their trade. From the farmer's perspective, adoption of the mobile phone is influenced by their level of education (Alampay, 2006). Therefore, there is an interaction between the structure (government extension agent) and the agency (level of education) when the farmer accesses information from the extension agents using the mobile phone. Eventually, the mobile-led network creates 'knowledge' which is a form of outcome for the rice producers.

3.3 Cultural artefacts and unit of analysis

The use of mobile technology that triggered the massive diffusion of connectivity in rural areas is not just about the functional capacity of the device but also the facilitation that allows the user to be able to communicate with the contacts more frequently and independently. How these rice producers utilize their mobile phone is also dependent on how they perceive the use of the mobile phones. This perception by the farmer is also influenced by the 'culture' of mobile phone use among the people of the rural areas. Therefore, the mobile phone also needs to be understood as a cultural artefact. The literature review section discussed the example from developing countries about how mobile phones benefit rural people by facilitating market information, saving time for traveling to distant places. At the same time, the mobile phone also has distinct characteristics of 'social logistics' that is based on a unique use culture (Tenhunen, 2008). Tenhunen's example of West-Bengal shows that the use of the mobile phones has an influence on the network and the inter-relationship within the village by strengthening the relationship with relatives and friends from distant places.

The framework discussed the interrelation with the social and commercial contacts and the farmers. Structuration theory (Giddens, 1984) clarifies the dualism in the system where the structure and agency both have an influence on each other. How the rice producers create the commercial and social contact and if there any similarity of the networks they create will be determined by the mobile phone usage culture of these rice producers.

Tenhunen's (2008) research on the eighty-seven participants from West Bengal between 2007-2008 with videos of the one hundred mobile phone users. The research shows the network of West Bengal was already very well connected. The use of mobile phones has added value by increasing these connections. The research shows that the use of mobile phones is predominantly for social purposes. Therefore, the frequent

communication with the family friends creates social logistics. According Tenhunen (2008), the social logistics is a tool that develops the knowledge through the interrelationship between technology, culture and social structure. The social logistics that the rice producers create by using the mobile phone that is also reflected like the network these farmers explained the cultural pattern by these rice producers (Tenhunen, 2008).

Therefore, how the mobile phone is perceived is explained by the shared meaning by the rice producers. From the ontological perspective, the technology has been perceived as a device that is assigned a purpose by the rice producers. This concept of cultural artefact extends the meaning and the impact of mobile phones from just the functional dimension.

Methodologically, the unit of analysis refers to the smallest object of analysis for the particular research. This is important to address the fundamental research problem. There is also a significant linkage between the conceptual framework and the unit of analysis. The framework introduces two dimensions that intersect and creates socio-technical provisioning. The unit of analysis in this research are the rice farmers who use mobile phones, and create social and commercial networks. The networks will be analysed to understand the socio-technical provisioning of the rice producers. The network will be able to explain the motivation for using a mobile phone. Within this unit of analysis, the motivation is also dependent on the rice producers' choice, education and other socio-economic indicators (agency influences) that incorporate the structural and the agential dimensions of the rice producer. This unit provides the information for the conceptual framework, which ultimately provide the research answer.

3.4 Chapter Summary

The chapter began with the fundamental research problem and the research paradigm, followed by philosophical foundations that discuss the ontology and epistemology of the research. After the philosophical discussions, the theoretical framework has been discussed. However, the theoretical foundation has a background and the building blocks that explain how the different components are interlinked and lead towards the theoretical framework. The discussion related to the framework explains how the philosophical foundations are also related to the research problem and the framework that lead to the explanation of the research problem.

The section also discusses the theoretical components that address various aspects of the rural rice producers' interactions with the social and commercial networks. The application of network, Choice theory, RBV (Resource-Based view) and Structuration theory has been discussed, and they are utilized to develop the conceptual framework presented in this chapter.

The unit of analysis in this chapter explains the integration between the research philosophy, theoretical framework and methodology. The unit of analysis also provides the basis to explain the relation between the theory and the appropriate qualitative and quantitative data requirements that will be discussed in detail in the following chapter.

4. Methodology

4.1 Introduction

The philosophical assumptions of the methodology of this research have been presented in the previous chapter. In this chapter, the processes that have been adopted to conduct the research according to the research design followed by the data collection techniques and challenges during the research and data analysis have been discussed. The literature review section presented the evidence of mobile telephony's impact on rice producers. In this research, the mobile phone is considered as the primary communication medium that facilitates commercial networks among rural rice producers. The nature of commercial engagement among these producers will be considered as a central theme. The focus is on network building, and the intention is not to analyse the actual impact of communication on rice farmers' business. By 'social engagement', the research considers the pattern and frequency of mobile communication and the content that is being shared among the farmers. Therefore, the research primarily considers the 'mobile phone' as a communication medium, which becomes more than just a 'talking device' on the move, but also a social artefact (Katz, 1993).

As for the participants, the rural rice producers have been selected since Bangladesh is the fourth-largest rice producer in the world (CRI, 2014). Particularly in the rural areas of the Bangladesh where agriculture is the primary activity of livelihood, rice production is one of the main livelihood strategies adopted by rural dwellers. Agribusiness in Bangladesh facilitates 60% of rural employment (CIA, 2016). Therefore, to represent small entrepreneurs, rice producers have been chosen for the research.

4.1.1 Methodological Approach and Design

Unlike ICT/IS research, this research uses the mobile phone as the primary communication device, which allows rice producers to exchange social and commercial information. This emphasis on the communication requires understanding of the critical issues related to commercial knowledge creation and social context relevant to their network creation. This approach in this research enabled us to attempt to understand phenomena whereby this communication between rice producers and their commercial engagement relates to their commercial capital creation (Walsham, 1997).

The appropriateness of the research approach is dependent on the philosophical assumptions this research is based on. According to Harrison, (2013), post-positivist research has an objective view of reality. In the research, the ontology is perceived from a structuration theory perspective, based on which the framework has been established. The purpose of the framework is to conduct the study that is generalizable to the farmers who use the mobile phone. The motive of the research is different from the traditional view in which interpretive research focuses on the understanding of the multiple realities that exists and do not predict them (Harrison, 2013). This research adopts a pragmatic approach that not only aims to discover the pattern but also explains the pattern and their reasons.

Therefore, this research falls into the epistemological debate such as positivism versus interpretivist (Venkatesh, et al., 2013). However, the choice of mixed method research depends on the research aims and question that determines the suitability of a multi-method approach.

According to Venkatesh, et al., (2013) the selection of the multi-method approach is dependent on three important elements -

- Appropriateness
- Development of meta-inferences
- Assessment of the quality of meta-inferences

This research question will be explained through the framework presented earlier (section 3.2). The framework requires data on the rice producers' agency influences such as age, gender, and education. To be able to explain the existence of social capital, an in-depth understanding of the rice producers is required. Therefore, designing a multi-method approach is appropriate for this research.

The research not only requires the different types of data to explain the rice producers' use of mobile phones but it also explains the phenomenon from different social dynamics such as their individual influences and embedded practices that influence their network creation aspects. Therefore, the different sets of data using different methodologies creating an inference about rice producers network creation. According to Venkatesh, et al. (2013) the assessment of the inferences is dependent on the validation of qualitative and quantitative research independently. In the following section (section 4.1.2) the validation of qualitative and quantitative method has been explained.

The data collection methodologies were both qualitative and quantitative. Along with case study data, survey data have been used that provides further insight in to the impact of mobile phones owned by the rice growers to facilitate commercial engagement from a broad perspective. The research questions require both a deeper understanding through the case study approach by conducting in-depth interviews of individual usage and the survey approach to elicit patterns of behaviour over a wide number of people from different districts for 'comparability'. This is vital for this research to be able to relate the data from these different sources, which will answer the research questions.

4.1.2 Mixed Method Approach

From a methodological perspective, there are specific priorities, such as statistical 'generalizability' for representativeness in quantitative research and analytic generalizability in qualitative research (Huberman & Miles, 2002). However, for this particular research, the mixed method was rather a rational methodology choice since the research questions ask both clarification on the conceptual framework, which required an in-depth understanding, and a generalizability of the concepts, which required a qualitative approach.

To conduct the research, multiple data sets have been collected applying diverse approaches and methods in a manner such that the combination of these methods is expected to result in complementary strengths and non-overlapping gaps (Johnson & Onwuegbuzie, 2004). The validity of mixed method approach includes the validity of both quantitative and qualitative methods. In the quantitative part the validity covers three different categories: designed validity, analytical validity, and inferential validity (Zachariadis, et al., 2013). In the quantitative research, the design validity refers to internal and external validity. The former refers to the correlations discovered in explanation, and the latter indicates the results through the data that can be generalized. In this study, both internal and external validation is required to be able to provide the understanding of the process of the conversion of information through the mobile phones to resources. The generalizability is also vital to learn how representative this framework is for the rice producers of Bangladesh. The analytical validation includes the reliability of the data and the concept validity, overall indicating the degree to which the variables are utilized in the framework in order to explain the phenomena. The inferential validity refers to the conclusion based on the statistical analysis for the research. In the research, the statistical components will establish the structural properties that

represent the existence of the social and commercial contacts that the rice producers depend on.

In the qualitative research, the validation has different meanings depending the research design and perspective (Venkatesh, et al., 2013). However, the validation is still very crucial for qualitative research. The same three categories are considered in terms of how the research is designed; execution (design validation), data collection, analysis and findings (analytical validation) and the interpretations (inferential validation). Therefore, the framework components that have been explained through the interrelationship between the components (section 3.2) is the design validation of the research. The following section (section 4.3) provides the plan for analytical validation and the outcome based on the plan is the inferential validation for this research. However, the fundamental question in this regard asks how the chosen mixed method approach is relevant for this research. According to Salehi & Golafshani, (2010), the research question defines whether the research study is good, not the research method. Therefore, the purpose of the mixed method has some specific purposes that serve the research which are:

- Triangulation
- Complementarity
- Development
- Initiation
- Expansion
- Enhance findings

According to Jack & Raturi (2006), the triangulation of research is founded on three justifications; completeness, contingency, and confirmation. The completeness indicates how these two sets of data from mixed methods to complete the research objective. In the research, the data required for both case studies and survey provides two different set of data that is required in order to explain the framework. Therefore, for the study these two sets of data complete the research. The contingency refers to the methodology necessary to be able to understand a deeper phenomenon that is

complex and requires information for an explanation. In this research, the creation of different forms of resources is ingrained in the practices of the rice producers. To be able to understand their use, in-depth interviews are to be conducted along with surveys to collect general information about their use of mobile phone. The third rational confirmation indicates how the use of mixed method was necessary for the research to draw the conclusion. In the research, the framework is not stablished on the data from survey data alone, as the existence of choice, social capital, and resource-based view look into their nature of mobile phone use - that requires both types of data to complete the research.

The complementarity explains the importance to understand how the use of different data sets obtained through different methods complements the research to develop the key findings. In this research, the data collected from using mixed method complement by providing the complete understanding of the phenomenon.

The development indicates how the data collected from one method is used to develop the result obtained from another method. In this study, the survey data on the contacts using the mobile phone shows the existence of social or commercial contacts. This information along with the in-depth interviews with the rice producers indicates the existence of commercial or social capital exist along with the commercial and social contacts.

The expansion indicates the use of multiple methods that explores the specific aspects of the phenomenon and expands the study combining these two different sources of data. In this research, the survey data provides a broad understanding of the components of the framework. The in-depth interviews along with the survey data expands the understanding that answers the research questions. It is important to understand how the use of different data sets obtained through different methods

complement the research to develop the key findings. Therefore, the mixed selection method is appropriate in order to answer the core research questions.

This research incorporates two methods for data collection through the implementation of surveys and case studies, using the same questionnaire for both in order to extend the scope and extent of the research. Simultaneously, the data from statistical analysis and the case studies will provide the explanations of the different components of the framework (section 3.2) which represent the research objective.

The key challenge in adopting a mixed method for this research was to design the framework that analyses the emergence of data from varied sources to present the basis for the analysis. Qualitative data provided irrefutable data on a rice farmer's preference or priorities on mobile phone use for commercial/social purposes. On the other hand, data gathered through case studies are meant to provide a 'constructive' perspective of the mobile usage pattern of rice growers, indicated contrasting perceptions. This debate, from a practical point of view goes beyond the ontological and epistemological differences between the qualitative and quantitative method and uses this discussion to introduce a pragmatism paradigm (Onwuegbuzie & Leech, 2005). This pragmatism brings challenges in terms of the way in which these different interpretations come together to answer the core research questions of this thesis.

However, to generalise the research findings, especially to establish the linkage between different forms of capital/resources and mobile phone usage for commercial purposes, a large data-set from six hundred respondents has been collected. The data collected through the survey and the quantitative analysis corroborates the interpretive approach through this research. An 'integrative research approach' (Johnson & Onwuegbuzie, 2004) was found to be appropriate, where the findings from both interpretive and quantitative approaches had complementary impacts.

The data is gathered for the research through the in-depth interview, and survey was inclined to provide deeper understanding of the phenomenon. Therefore, it is an interpretive approach based on the philosophical assumptions of the researcher (Myers, 1997). For this research, a parallel period has been selected as the research requires a comparison between both sets of data for congruent findings (Creswell, et al., 2003) by obtaining both quantitative and qualitative data within the same time frame from the sample, with similar characteristics. In this particular mixed method research, it relies on the qualitative component of the data to provide the constructive and critical aspect of the research, in parallel acknowledging the quantitative data gathered through survey. The advantages of this mixed method were apparent when the independent data sets came together, which also reduced the uncertainty of the interpretation solely through case study analysis. Through this mixed method, reliance of one particular measure reduces, and it increases confidence on this research by minimizing chances of error.

The fundamental question of this research lies in a subjective understanding, and when verifying the outcome, the research refers back to the 'selected' theoretical basis. Here, the interpretations and understanding are influenced by agency theory along the concepts such as choice and social network by the researcher. Combining the quantitative method in this research provided a contextual richness that also improves internal validity and interpretation of qualitative findings.

4.1.3 Case study approach

According to Cronin, (2014), the definition of case study research is problematic as it involves both the design and the method of the research. Furthermore, the terms 'case study', ‘case study method' and 'case method' are used interchangeably. However, case study research focuses around a specific situation to provide a description of an individual or multiple cases (Cronin, 2014). This allows the researcher to investigate the details of the particular situation that includes either an individual, group or a phenomenon. Case studies generally imply qualitative methods, with a small number of participants who are observed in the 'field' (Yin, 2009). In this research, the understanding of the rice producers' choice following the development criterion (Section 2.4.3) requires an explanation from the rice producers themselves.

The case, by definition is a basic unit of study. In this research, the cases reflect the rice producers’ mobile usage. According to Simon (Simons, 2009) “Case study is an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, program or system in a “real life” context” (Simon, 2009; p.21). In this research to understand the particular system of how the rice producers use mobile phones, in-depth interviews, the mobility map, and mobile phone itemised bills have been studied. These different tools have been utilised to explain the different concepts discussed earlier (chapter three). This type of case study can be explained as a disciplined configurative approach where the aim of the study is to provide an overall understanding of the phenomenon. The interpretations of the case studies are derived from the theories (Gomm, 2000). In this research, the interrelationships between the farmers and their commercial or social contacts are explained through the social/commercial capital.

In terms of conducting a case study, multiple sources of information were employed in order to gather data in various forms such as interviews, reports etc. on the particular case to reach the depth and breadth of the research object, (Ghauri, 2004). In this research, the case studies use in-depth interviews on the rice farmers of Bangladesh. Along with the interviews, a mobility map has been created to explore the communication patterns between commercial and social contacts of the rice farmers. The mobile phone bills of the participants were also collected to examine their communication trends in different seasons.

Along with the choice, the actual development outcomes that may come in forms of intangible resources such as social capital requires an in-depth conversation with the rice producers that will provide the understanding of the phenomenon. According to Yin (2009) the case study is an empirical analysis that investigates the phenomenon within a real-life context.

The analysis of the case study is utilized from a particular logic that has a generalizability for a theoretical proposition (Kennedy & Luzar, 1999). In this research thesis, the case studies are required to provide the basis to explain the framework. This specific way of using the case study to achieve the explanation is referred to as 'analytical generalization' by Yin (2009). The selection of case studies as an approach is chosen as the research required understanding the phenomenon that needs to be distinguished from complex social interactions of the farmers.

This research requires more data that is specific to the context of mobile phone use by the rice producers that the survey approach cannot capture. Within the mixed method approach, the case study requires the design to be able to utilize and support the overall research objective. According to, Yin (2009) there are five components of case study design; a study question, a study proposition, unit of analysis, the logic behind how the data from the questionnaire links with the proposition, and the

interpretation that analyses the phenomenon that this research intends to conduct. In this research, multiple cases will be selected in order to understand the similarities or contrasts between the farmers with regards to their mobile phone usage. The theoretical framework (Section 3.2) based on which the questionnaire has been designed will be able to explain the phenomena through the case study responses. These cases therefore, provide a rich theoretical basis for the research (Yin, 2009). However, the theoretical framework of this research that is based on the literature on the rice producers explains how the phenomenon that is being explored is likely to be answered through the responses of the case study. The responses later provide the generalizability or the logic that the research founded on.

Case studies are useful in circumstances when little is known about a phenomenon such as the impact of how the 'use of the phone' translates to any form of resource/capital for the farmers (Yin, 2009). The case study approach provides an in-depth understanding of the communication patterns, network-types, and content shared through the network, while taking the properties of the network into consideration, such as duration and frequency of the communication.

The egocentric approach to analysing a participant's network has been considered in this research, which allows the researcher to conduct an in-depth investigation using mobile network data. This thesis uses egocentric data to be able to compare mobile use between mobile users for commercial communications.

In general, case studies define the boundary of the case before learning about the phenomenon within the set boundary. A multiple case study approach or the analysis of several cases allows the understanding of similarities and differences between the cases. Recognition of the commercial interactions in different cases where different types of commercial networks have been formed requires prolonged engagement with the mobile phone users. Direct observation accompanied by interview with mobile

users enabled the exploration of participants' explanations about the content of the communication. For this research, the case study was utilized where actual communication flow was observed and explored to determine how these flows are linked with formal or informal communication channels. Therefore, measures of flows of communication supported the definition of the relationship patterns (commercial or non-commercial) between the actors within the network. This pattern of analysis identified the density and intensity of the commercial information. The network analysis facilitated the exploration of the relationship (dyadic or non-dyadic) of the mobile users to a wide network that creates the boundary of the close network (Laumann, et al., 1989).

For the mobile phone-led network among rice producers, it was important to understand the network-structure that encapsulated their patterns of relationships, interactions, and communication processes over time. All these inputs indicated the information flow and communication behaviour of the actors within a network. The changing nature of communication influences the actor's behaviour within a network, resulting in creating the network to being more 'dynamic' in nature than static. As an example, when one mobile user enters a particular community group by a profession such as a farmer in rural Bangladesh, invariably the actor becomes part of the rice producers' network. The background of the research (Section 2.3.7) discussed the seasonality and the type of rice having an impact on the pattern of communication among rice producers. Therefore, the pattern of communication that exists in the rice producer' network and the ways in which they interact are likely to differ from other networks.

4.1.4 Survey research approach

The survey approach refers to a group of methods, which emphasize quantitative analysis where data from a large number of participants are collected through methods

of questionnaires. This data is analysed using statistical techniques. By studying a representative sample of farmers in Bangladesh, this research sought to understand relationships that are common across regions among rice growers. In this particular research, the survey data provides a broad generalizable use pattern of mobile phones by the rice growers. The survey was conducted on six hundred rice growers spread over 10 districts of Bangladesh. This survey data, along with case studies, provides the confidence of generalizability for linking the mobile phone usage with commercial capital since. "Without the survey data, the observer could only make reasonable guesses about his area of ignorance in the effort to reduce bias" (Vidich & Shapiro, 1955; P31). Details of the questionnaire formulation, testing, data collection and analysis are presented below in section 4.3.

Survey approaches are conducted in extensive research, as they are capable of gathering comparable information from a wide number of participants. The research problem and research design dictate the survey approach (Rea & Parker, 2014). The survey approach is also determined by the information that is required for the survey. According to Rea & Parker, (2014), the survey approach collects three types of data, descriptive, behavioural and attitudinal. The descriptive data refers to the information about the participants. Such as in this case the age, education, gender of the rural rice producers. This data provides the broad understanding and the information that relates to the agential dimension (section 3.2) of the rice producers. The behavioural data includes the data related to the behaviour of the participants, such as in this research the nature of mobile phone usage of the rice producers. This behavioural data of the rice producers involves their frequency of mobile use, and the way in which they conduct business using the mobile phones. The attitudinal data reflects the opinions or attitudes of the participant on the chosen subject matter, such as in this case the use of mobile phones. The participants of the research will provide information through

opinions on usefulness, timeliness, relevance and the importance of mobile phone usage, all of which will provide the information for the framework.

Before conducting the survey, it is important to reflect on the concept and the selection of indicators that will be reflected on the survey questionnaire (De Vaus, 2013). The concept is referred as to the fundamental design based on which the research chooses the survey approach. According to De Vaus, (2013), this concept summarises the whole set of behaviour and attitudes that have a commonality which does not have meaning independently. In this research, the framework of the research provides a meaning in conjunction with the information provided through the survey data and case study - but independently, the framework is a collection of theories related to a description of the process. However, this concept is created to show the process of how the rice producers create the resources using the mobile phones.

The indicators that will be required for the concept or the framework therefore, do not have meaning independently on their own, and the key issue is how meaning is obtained from these indicators by applying them to a framework (De Vaus, 2013). Therefore, it is not important whether these indicators are true or false, but how they give meaning through the framework.

The process according to De Vaus (2013) of selecting indicators for the framework requires moving from the broad understanding of the concept of specific abstraction to relate to components of the framework. In this framework, the structural dimension indicates the existence of social and commercial contacts. This existence can be stablished by the indicators such as commercial contacts in the mobile phones of the rice producers. Their communication with the network shows the social or commercial capital for the rice producers - therefore the small indicators relate back to the component of the framework.

The questionnaire was designed to gather information on a user's communication with commercial, social and socio-commercial contacts, which leads to the possible answer to the research questions. Earlier, the literature review discussed various aspects of capital creation and how through communication, actors within a network create resources. The questionnaire was constructed to obtain data on a farmer's resource creation process. An emphasis was given to explore how the survey data complements the analysis through network data of the selected case studies. The case studies highlighted the relationships between farmers' internal networks and the content of their communication that has been exchanged, which links to the broader connection between 'use of the mobile phone' and the creation of 'commercial capital'. The survey, on the other hand, had same questions as case studies that incorporate a farmer's socio-demographic data and their commercial/social contacts, which provides important information regarding a network relationship within rural communities and commercial networks beyond local communities from 20 different districts of Bangladesh.

Chapter three discussed the theoretical components that are important for the research. These theoretical components include agency, choice, social network, institutions, resource based view and social capital. The questions related to these concepts was prepared prior to the field-trip. A pilot project was conducted to gather the information based on the questionnaire. The initial field visit was conducted in December 2012 along with MPower Social. The questionnaire (Appendix 1) was further refined to better capture the details from the participants of the research.

4.2 Overall Methodological Outline

The research problem that particularly focuses on the rural rice producers' mobile use for commercialization and the commercial benefit is a complex social phenomenon.

The major two components of the framework, the agential dimension and structural dimension discuss the agency structure, network, institutional theory and choice theory (Chapters 5, 6). In the following section, an overall methodological outline has been presented followed by the construction of the questionnaire based on the outline.

4.2.1 Framework Component One: Agential Dimension

The first component of the framework discusses the agency influence and choice. The questionnaire for the research was constructed to include the following indicators to explore the agential dimension of the rice producer. There were both survey data and case study data for the following indicators.

Theory	Reason	Questionnaire
Agency	The structuration theory requires data related to the individual rice producers about their agency influence and also the data from a representative sample about their interconnection with the structure.	Age Gender Education Trust Farm Size Years of mobile phone
Choice theory	The choice theory has implications for the types of choice the farmers make on using mobile phone, deciding on the type of network they create and how frequently the farmers use mobile phone for commercial or social use. Therefore, to be able to establish the choice preferences the survey data from representative and the case study data is important to provide their opinions about their choice.	Importance Increased commercial contacts Information relevance Timeliness Trust How frequent use of mobile phone compare to other media Geo location

Table 4.1 -Methodological outline 1: Agential Dimension

4.2.2 Agency and choice related questions

Agency perspective in the research has been categorized as the individual rice producers' influences such as the age, education, and gender, that impact on how the farmer adopts the use of mobile phones for commercial or social use. The case study data along with the survey data provides further detail on how the rice producers' use is affected by these indicators. The survey questionnaire also incorporates rice producers' level of trust on the information that determines user's impact on network building and the geographic locations of the rice producers.

The choice related questions include how the mobile phone allows the user to communicate more frequently with their commercial contacts. The research used both survey data and phone use data, which were obtained from the mobile phone operator. The average usage frequency is obtained to provide information about the choice of the rice producers to use the mobile phones. The increase in the number of mobile contacts indicates a certain impact of mobile phone for the farmers. The 'timeliness' of data availability is a unique feature of the mobile phone, and the question of timeliness provides information on how the user considers the information received through the mobile phone to be timely for their commercial purposes. The relevance of information is important for the farmers to benefit from the communication exchanged with their commercial contacts. The questionnaire also incorporates questions on the relevance and degree of importance of commercial information to the mobile user.

4.2.3 Framework Component two; Structural dimension

The second component of the framework discusses the institutional influences, the commercial network created by the rice producers. The questionnaire incorporates the indicators (discussed in the following table) to understand the Structural dimension of the farmers

Theory	Reason	Questionnaire
Social network	The social network theory to be able to explain the nature of network requires in-depth information - therefore case study data. However, the information regarding the social and commercial type of network or the type of relation the rice producers create by using mobile phone requires a representative sample data.	Seasonal impact on network How contact is made with buyer/supplier Frequency of communication What other different media to contact Nature of frequent contacts
Institutional theory	The institutional theory discussed the existing practice relating to the rice production organization. The quantitative data from representative sample provides the overall picture of the institutional practice and the qualitative data on the individual rice producer will provide the perception and individual practice within the institutional environment.	Buyer type Supplier type Distance between the commercial contacts Types of business transactions How they communicate with partner/employee How they communicate with government agencies

Table 4.2 - Methodological outline 2: Structural Dimension

4.2.4 Network and institutional influences related questions

The questionnaire includes data on the seasonal impact. The mobile network data on the selected rice producers includes call data on the harvesting and pre-harvesting seasons to compare their commercial use in these two different periods. The questionnaire also includes data on how the rice producers use the mobile phones to contact the input supplier/buyers. The frequency of communication with the commercial contacts and the different types of media used to communicate with the rice producers is gathered for the research. Frequency and length of communication with the top ten commercial contacts of the case study participants were analysed from their mobile network dataset to learn about their network strength. The different types of buyers and suppliers for the rice producers along with the different types of business transactions is covered in order to provide information on the rice producers commercial network.

4.2.5 Framework Component three; Socio-technical Provisioning

The third component discusses the indicators (e.g. choice) that interlink between the agential and structural dimensions. The survey and case study data, there were comparisons between the frequency of communication and relevance of information received through use of mobile phone. The similar comparisons indicate the socio-technical provisioning.

Theory	Reason	Questionnaire
Resource based view	Data related to the resource-based view is primarily about the rice producers' perception of mobile phones as a commercial resource. This requires case study data that explains the rice producers' rationality behind mobile phone usage for commercial purposes.	• Relevant of mobile phone • Frequency of communication • Timeliness of mobile phone • Number of commercial contacts. • Case studies on preferences and use of mobile phone. • Importance of mobile phone

		• Different types of media to communicate • Commercial content exchange
Social Capital	The social capital discussed in the theory is related to the social network the rice producers create. This social capital is also linked with the nature of their network. The case study will provide the in-depth understanding about the farmers created social capital and how it is linked with their commercial engagement.	• In depth interviews about the nature of the network. • Social network analysis of the case studies.

Table 4.3 - Methodological outline 3: Socio-technical provisioning

4.2.6 Commercial communication related questions

The questionnaire data on the relevance of information on the mobile phone and frequency of communication is gathered to compare between these two datasets. Similarly, the number of commercial contacts and the timeliness of information are compared to understand the relationship between these two datasets. The individual rice producers' reflection on their timeliness, importance and relevance were gathered. The social network analysis of the individual rice producer was gathered through the case study analysis. The information on rice producers' business transaction and commercial content exchanged was also gathered through the case studies and survey data.

4.3 Local research support

This PhD is funded by the Bangladesh Ministry of Science and Technology as part of their program to explore and roll out advanced information and communication technology to the rural people of Bangladesh. The particular emphasis of this program was to learn and explore the area of information communication and technology for development, and how it impacts the rural people in a broader context. The initiative was also part of the 'Vision 2021', a mandate of the present government (as per their election manifesto) in which ICT has been recognized as the mainstream development tool. It coincides with the implementation of the UNDP project titled *Access to Information, A2I*. For strategic reasons, this project is now housed in the Prime Minister's Office (PMO). The major collaborator of this research includes the Ministry of Telecommunication, Ministry of Agriculture and MPower Social. A brief description of these organizations has been included in the following section.

4.3.1 Ministry of Posts, Telecommunication and Information Technology

At the initial phase of the research, the discussion took place between the researcher and the authority on the way in which mobile usage data could be obtained from the telecom operator TELE TALK, a government-owned mobile phone operator. However, due to legal restrictions, it was not possible to access user data at a later stage for this research because of the data policy of the country. The Ministry of Science and Technology is the funding authority for this research, and there was no other direct contribution in terms of data or resources that have been made by this ministry.

4.3.2 Ministry of Agriculture

The Ministry of Agriculture consists of several departments and research institutions. The data collection for the research required access to information regarding rice farming in Bangladesh. Two departments of the Ministry of Agriculture (DAE -

Department of Agricultural Extension Services) and the AIS - Agricultural Information Services) provided invaluable information regarding the farmers, land ownership and land types for the rice farming.

4.3.3 DAE

The DAE is responsible for 13,000 extension workers throughout the country and is in charge of 14 agricultural training Institutes. DAE runs a number of horticulture centres and plant quarantine centres. The extension staff uses facilities at the Farmers Information and Advice Centers, which were being established in each Union Parishad. For this research, the DAE provided assistance through guiding the researcher to the chosen location and provided information about the selected farmers and detailed demographic information of the location.

4.3.4 Agricultural Information Services (AIS)

Although relatively small, the organization has agricultural experts in different regions of Bangladesh. In particular, the AIS website has a large number of resources for the farmers and agricultural extension workers. AIS also published agriculture related resources in the native language of Bengali. AIS provide material for the agricultural programs on TV and radio channels that have been broadcast for decades throughout the country. For this research, AIS provided local contacts to access institutional resources. There was also secondary data provided by AIS from their call serviced, which benefitted the research.

4.3.5 USAID-Feed the Future

The U.S. Government's Feed the Future initiative works with the Bangladesh government in a five-year plan to improve agriculture, food security and nutrition. Feed the Future (FTF) resources are aligned with the national policy to increase agricultural productivity. The initiative began in early 2010, when the Global

Agriculture and Food Security Program (GAFSP) was awarded $52 million by the World Bank. The researcher was introduced to this initiative through MPower (discussed in the next section). Along with the Ministry of Agriculture, the USAID initiative provided assistance in visiting different FTF areas where there are farmers; particularly rice growers were identified to conduct a national scale survey for their ICT use.

4.3.6 MPower/USAID Project

MPower was previously known as Click Diagnostics Inc., which was founded by graduate students from Harvard University and MIT in 2008. It started its operation in Egypt and later expanded to different countries in Africa. In 2010, MPower started its operation in Bangladesh, partnering with BRAC, the largest NGO in the world.

MPower was chosen to collaborate for data collection for this research, since there is a five-year ongoing project between MPower and the Bangladesh government, in collaboration with USAID. This particular project was beneficial for the research, because of its focus on information communication technology in rural settings of Bangladesh.

MPower is a social enterprise based in Bangladesh that works in various interdisciplinary projects related with information communication technology in Bangladesh and abroad. MPower's project on agriculture, which is funded by USAID, also partners with CARE Bangladesh and the Dhaka Ahsania Mission (DAM). Jointly, the consortium is responsible developing an ICT-enabled extension service that will benefit the nation's government to extend its current outreach capacity. At the initial phase of their program, a baseline study across the country to assess the overall ICT need among farmers has been commissioned. MPower staff members from different

regions of Bangladesh were assigned to conduct a survey on the 'ICT's use of farmers' in selected regions.

4.3.7 MPower's role as facilitating the research

The research requirement has been discussed with MPower management, and as part of the agreement, the questionnaire was shared with MPower agriculture to be able to mutually benefit from the baseline study conducted by MPower. The questionnaire prepared for this research was shared with the ICT communication specialist at MPower, to gain insights about the linguistic challenges and survey techniques that are suitable for rural rice producers of Bangladesh.

4.4 Data collection and field visits

4.4.1 Sampling Strategy

For the quantitative analysis, the six hundred participants have been selected (the details of the participant selection have been discussed in the following section) from Bangladesh spread across six different divisions and ten locations. The two sets of data were collected utilizing two separate sampling strategies, using pre-defined criteria for participation, effectively making the selection process 'purposive sampling'.

However, the research also required access to the user's mobile phone and a discussion of the mobile use of the participants. In rural areas of Bangladesh, unless the participants know the enumerator or the researcher in person, it is unlikely to discuss details about their use of the mobile phone. Therefore, the research isolated the rice farmers for this particular research by specifying criteria. The enumerators who assisted in this research went to their respective villages to collect data from their local areas. This particular selection process also affects the sampling method as for the sake of authenticity and quality of data gathered. Therefore, along with the

purposive sampling, a 'convenience sampling' technique have been utilized to be able to access to the participants who are better suited for the research. For the survey, 'homogenous samples' have been chosen (Patton, 2005), which give a detailed picture of a particular phenomenon. In this research, the participants have been selected from rural sites that use the mobile phone to communicate with his or her social and commercial network. Since the participants from different districts have been chosen using the same criterion as rice producers, they belong to the same subculture or have the same characteristics. For the case study, a 'typical case sampling' (Patton, 2005) has been chosen because the research required a detailed profiling of the participants. This sampling method requires a prior knowledge about the responses, which places these respondents as a 'typical' sample of a rice producer who uses the mobile phone.

4.4.2 Participants

The selection criteria for the rice growers for the research is as follows:

- Mobile user for over a year
- Age 20 and above
- Rice grower as a main profession

The minimum period of owning a mobile phone was considered to be one year because the 'mobile phone' in rural Bangladesh can be seen as an adoption of a new technology. Therefore, considering the people who have been using the mobile phones for at least a year is indicative of whether they know how to use a mobile phone, at least to the level where they are not unfamiliar with its use.

The ages of 20 and above were chosen for the participants because a national consensus from 2011 (BBS, 2011) shows that the skilled farmers vary in age. The maximum number of skilled farmers increases at the age group of 40-44 (for men) and 30-34 (for women). However, the statistics also show that the age for farmers can be as young

as eighteen. Therefore, in order to get a good variation in different age segments, this range has been chosen.

The research required two different approaches to select participants: case studies and survey research. For surveys, participants were selected from ten districts where the USAID/MPower extension project operates. Although the USAID project supports different types of farmers, for this research, only rice producers from the locations were being selected based on the participants' criterion discussed earlier.

For case studies, the participants were selected from two locations within the 20 USAID project areas based on the willingness of the participants to share the information on their mobile phone usage. Although the demographics of the participants are the same for both case studies and survey methods, the selections for case study participants required additional criteria to be able to provide network data and willingness to participate for longer periods for interviews.

4.4.3 The Enumerators for the Research

As part of the arrangement, MPower facilitated a team of surveyors who conducted the survey along with the researcher in different districts of Bangladesh. These individuals from MPower were selected (section 4.4.4) for the research as enumerators. The survey team members were local graduates with previous experience in data collection in rural areas. These surveyors required a thorough understanding of the research questionnaire, along with training on theoretical discussions relevant to the questionnaire, which enabled them to be able to collect the data efficiently. The researcher conducted the training, and the contents of the training discussed 'social capital', various forms of capital, communication and a specific focus on communication through the mobile phone. In the training session, the questionnaire was discussed thoroughly to be able to make the rural rice producers understand the research questions.

The selected enumerators had a farming background, which gave this research access to farmers in informal settings. This selection was also necessary because of the requirement to access farmer's mobile phones to verify their opinions and discuss their mobile phone usage. Because of the ethical considerations of the research, the surveyors were required to have a verbal consent from the farmers prior to interview. The surveyors were trained to provide a narrative about the research and its purpose. After confirming the participant's consent, the enumerator conducted the interview with the farmers and accessed their mobile handsets to record their lists of contact numbers and communication patterns. Among these enumerators, there were no female participants. The primary reason shown by the female enumerators was the nature of work in this research that required extensive travel to the distant locations. However, when the male enumerators went to villages for the survey, they took the support of the male family members of the female participants.

4.4.4 Enumerator selection criteria

The researcher selected the enumerators from the pool of members from the MPower data collection team. These participants are chosen based on the following criteria:

1. Active member of MPower with past experience in data collection in rural areas
2. MPower members that reside in Dhaka, but are from the list of selected USAID project locations where they have their families or extended family

4.4.5 Forms of Data

There are two methods that have been utilized to collect data – survey and case studies. The questionnaire that was selected on the basis of the pilot study (Appendix) has been utilized to collect both survey and case study data. Both case study and survey was conducted in parallel to capture the depth and breadth on the impact and use of mobile phone at the same crop season by the rice producers. All the data

collected for the research has been recorded on the questionnaires, and was collected through direct interviews from the participants. Creswell (2003) mentioned that there are four basic types of information for collection

- Observation
- Interviews
- Documents
- Audio-visual materials

For this research, the data was collected through in-depth face-to-face interviews and focus group discussions (Rabiee, 2004). Some instruments were developed/used, including open-ended paper-based questionnaires and checklists for the discussions, interviews and observations. This collected data was later transcribed to an SPSS (Statistical Package for the Social Sciences) document for statistical use. Along with the interview responses, the data from mobile phone use was collected from the users' operators. The itemized bill for the interviewers was collected as a printed document.

The secondary data was collected from the Bangladesh Statistical Bureau, Agricultural Information Service, and Department of Local Government. The data is related to the socio-economic indicators, demography of the location and mobile usage data of the rural rice producers. These data have been presented in interpretation chapter for comparisons with the data analysed for this research. There are also some geographic maps collected from Department of Bangladesh local government of the areas where the rice producers have been interviewed for the case study analysis.

4.4.6 Survey Data Collection Sites

The USAID feed the future program covers all of the sixty-four districts, including four hundred and ninety villages (upazilas) in Bangladesh. The first criterion for the selection of the rice producer was to obtain as much variation possible. There are eight divisions in Bangladesh; the researcher selected six divisions for data collections. Two divisions were hard to reach; Rangpur and Mymensingh, as the enumerators selected them were unfamiliar with these two divisions, and therefore collecting reliable data from these areas was difficult. There are geographical variations in different districts of Bangladesh. There are locations within the chosen districts that experienced extreme weather events (including two major cyclones in the last five years), man-made environmental degradation, flooding and prolonged water logging due to the collapse of embankments. There are also changes in the seasonality of rain, and salinization of soil and water, causing food and water insecurity. The following villages were selected based on the familiarity of the enumerators of the research and USAID area for the logistic support.

Figure 4.1 – Survey Locations

SURVEY LOCATIONS		
Divisions of Bangladesh	**Districts**	**Upazila/Village**
Barisal	Potuakhali	Golachipa
Chittagong	Feni	Dharmapur
	Comilla	Debidwar
Dhaka	Manikganj	Daularpur
	Tangail	Tangail Sadar
Khulna	Jessore	Kumarkhali
	Khulna	Paikgacha
Rajshahi	Bogra	Sonatola
Sylhet	Companyganj	Telikhal
	Biswanath	Raniganj

4.4.7 Case study Data Collection Sites

The case study was conducted on two locations within the survey sites. The selection was dependent on the availability of the mobile itemized bill for the participants. This was particularly challenging (discussed in the following section) and it was crucial for the researcher to be able to analyze the mobile usage patterns of the participants. Along with the mobile itemized bill, the participants were requested to allow at least two hours for the interview.

Similar to the survey method, the participants were chosen through the association with the enumerators, who are related through contacts in those locations. Prior to the interview, the participants were contacted and scheduled for a meeting. For the meeting, the researcher stayed in Comilla and Rajshahi for three nights each, per location. The researcher conducted five interviews from each location. The first location was in Bogra in Rajshahi. The researcher, along with the enumerator, had to travel by domestic flight from Dhaka. An AIS local officer arranged the accommodation.

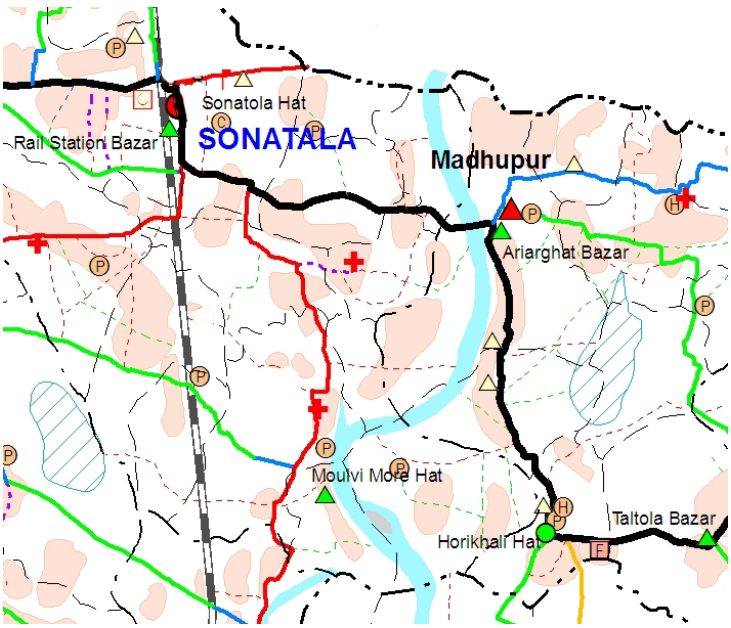


Figure 4.2 – Case study location 1 - (LGED, 2015)

The second location was also arranged and coordinated by the enumerator. This location takes five hours by road transportation from Dhaka.

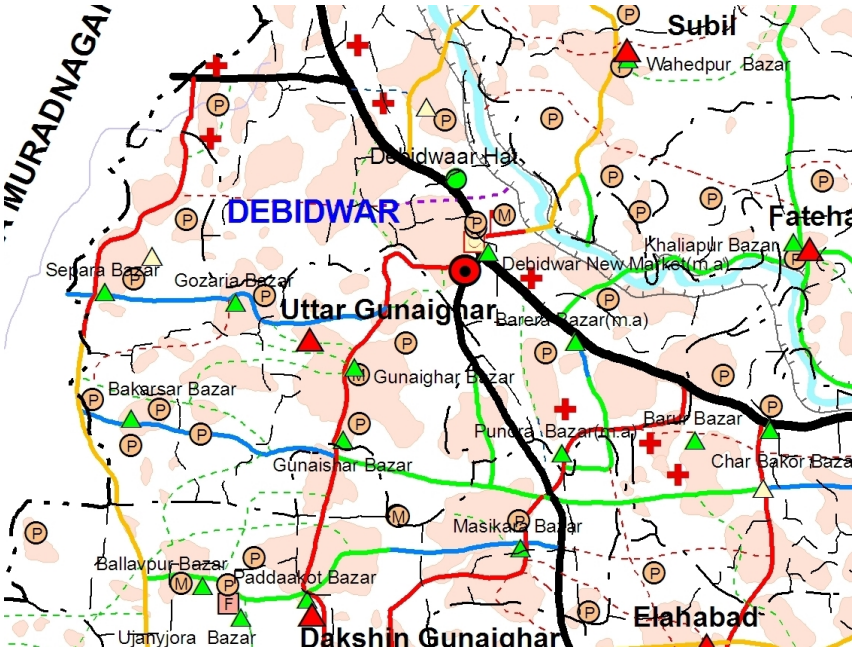


Figure 4.3 - Case study location 2 - (LGED, 2015)

4.4.8 Collection Process

Data was collected between April 2013 to September 2013. In order to be able to collect data from the various locations, the researcher travelled to those places and stayed overnight. The enumerators, prior to the visit informed these participants, so the participants and the enumerators could schedule the date according to availability and subsequently confirm. At the locations, the enumerators pre-arranged the interview session with the participants at their convenient locations. For some participants, it was on the yard in front of their house and some participants preferred to have the meeting in the market place among other farmers. On average, it took one hour to conduct the interview with the participants.

4.4.9 Mobile Phone Data Collection

The mobile use data of the ten participants for the case studies has been collected. This call data for the farmers was necessary for the research to analyze the users' voice-to-voice communication patterns. However, this call data is not accessible from mobile phone operators under the data-act law of Bangladesh.

Consequently, the only option available to collect mobile data required the research participants to apply for itemized bills. Before applying through the participants, consent from the participants was obtained. The process for applying through the participants required the actual mobile phone users to physically appear (along with a photo ID) in the customer services office of their respective operators, nearest to their location. Since these mobile users live in rural areas, the researcher had to arrange for their transport to the customer services offices, and accompany them during the process for the majority of the time.

4.4.10 Communication and Mobility map for the Case Study Location

To provide a broad scenario of the locations where the case study took place, the detail demographical information of the districts has been provided. A mobility map on the individuals of these ten participants has been created. The mobility map provides the details of those individuals' commercial contacts on a map that showing where they are located and how they communicate. To provide the details for their connectivity, the researcher also spoke to the local shopkeepers, suppliers, neighbours, government officials and senior citizens.

4.4.11 Recording Procedures and Storing Data

All the interviews have been conducted in the local language. All data was written on paper, which was later translated to English. The researcher used an IPad on the locations to be able to collect the data in various forms: written, video and audio formats. The enumerators were also involved in the process of translating the data to ensure the information was accurate and reflect what the participants described.

4.5 MPower Case study data

The dataset from MPower is a primary source, where the farmers' data has been collected continuously through the use of mobile devices available to the agricultural extension officers. The data is stored in the knowledge bank of the MPower server. The Knowledge Bank developed by MPower is a mobile-based application where the Knowledge Bank gathers relevant information from agriculture research agencies such as the Bangladesh Rice Research Institute (BRRI), Bangladesh Agricultural Research Institute (BARI), Fertilizer Recommendation Department, the Horticulture Centre, Bangladesh Jute Research Institute (BJRI), Livestock and Fisheries Research Institute, and the Department of Agricultural Marketing. All of these different institutes and research agencies digitize agricultural information on different crops, livestock and fisheries. Eventually, a database will be developed based on different agricultural segments. Furthermore, a visual identity on certain agriculture information is being provided through pictures and other multimedia materials. This information is updated through a central body of experts from different agricultural departments. This organization plans to meet every four months to update the information on new technologies and other related discussions on agricultural information.

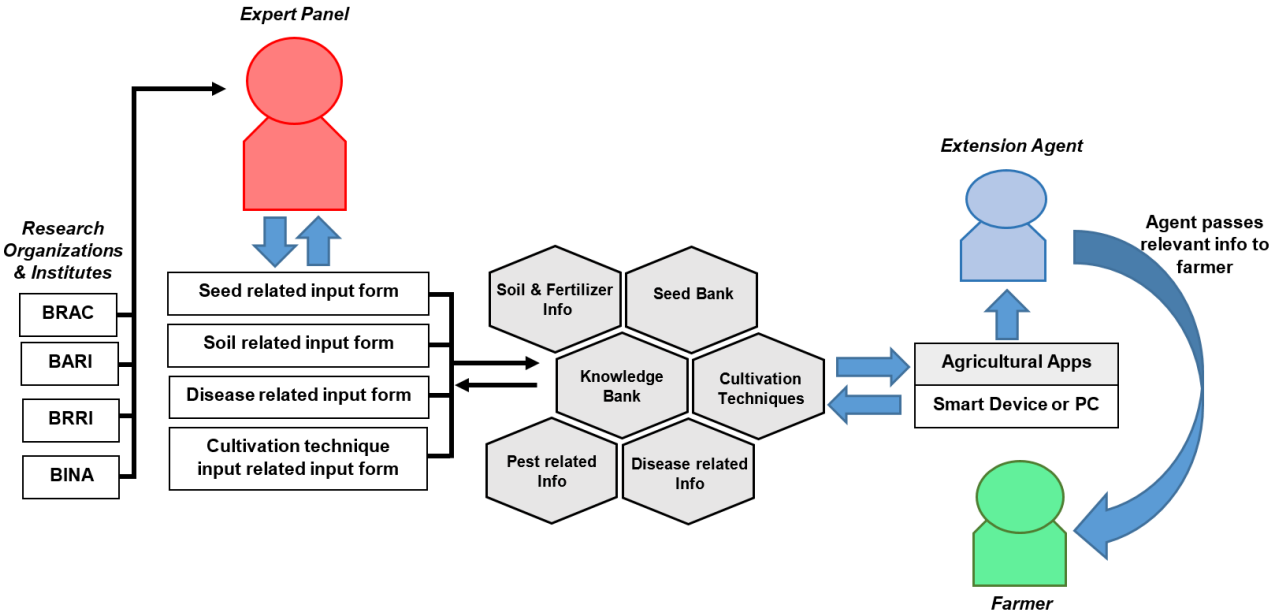


Figure 4.4 – MPower Knowledge Bank - Adapted from the MPower project document (MPower Social, 2015)

The knowledge bank has detail information of six crops. The initial screen (the homepage) of the knowledge bank application allows the user to select from the available modules. There are fifteen modules under the 'crop' category: variety, seed, cultivation, seed, weather, pest management, etc. Based on the choice, the user is directed to a particular module where the information on seeds, pests or diseases is available. Once the user selects any particular module, such as the pest module, a list of all the pest-related information is displayed on the screen. The details about the pest are available once the user selects the pest type. The details of a particular pest consist of its image, disease symptom, pest life stages, and times of infestation and preventive and curative measures. The details of the pests are presented in the local language of the end user. This service can be accessed through a mobile phone application provided by MPower and is available for the extension agents and the farmers who own some select mobile phone models. The application provides a pictorial guide to the queries for the farmers.

4.6 Researcher's involvement

The researcher was directly involved throughout the process of data collection in Bangladesh. The tasks involved conducting interviews, FGDs and observation. As agreed with MPower, the researcher had to provide technical assistance to the agriculture project by USAID. As part of the project, the researcher accompanied the USAID/MPower team in visiting central and south-central districts in Bangladesh. The USAID project also works in partnership with the Bangladesh Ministry of Agriculture. Therefore, this research benefitted from the access to resources from various agricultural departments in Bangladesh. The data collected through FGD interviews, meetings with government officials, agricultural and ICT experts and famers was stored and transcribed into English.

4.7 Challenges during Data Collection

During the data collation phase, there were several challenges in the process, in terms of commuting to the villages and communicating with the farmers in order to the right data from the participants. The following section discusses some of the challenges during the data collection process.

4.7.1 Influence of agricultural official's presence

The Ministry of Agriculture in Bangladesh provided assistance for the research through government extension agents that accompanied the researcher in the field. On certain occasions, the farmers were influenced by the presence of the government agents, and in particular, when there were questions regarding their communications for farming requirements, they seemed to provide biased answers about their communication with government officials. In a village setting, where the interviews took place in an open space, it was difficult to have a one-to-one conversation with the participants as because they are surrounded by family friends.

4.7.2 Agricultural season

The agricultural season impacted the communication patterns of the farmers. During the interview phase, the farmers were busy in their fields, and coordination was required in order to schedule meetings to conduct interviews. During the harvesting season, the participants were working mostly in their fields. Obtaining some time off at their convenience was difficult and the only time in which the participants were able to speak was during their afternoon break at the local tea stall, which is a common place for other farmers to come together for chats. Conducting interviews in these locations for a prolonged time was even more difficult as they had little time for the interview and were surrounded by local community members. On some occasions interviews required second sessions to be scheduled in order to complete the questionnaire.

4.7.3 Information from government officials

Obtaining information from government officials was sometimes very difficult and rare. During the interview sessions with the extension officials, the data provided was based on their assumptions and prior knowledge. The data that the participants provided such as their land size was to be verified by the government officials, and was sometimes hard to arrange as these officials were always commuting to distant places, therefore required multiple appointments for their availability.

4.7.4 Staying in villages

Staying in the villages was at times very difficult, as there are limited basic facilities such as electricity, safe water, and sanitation in rural areas. Staying in the villages was essential as, most of the participants do not live in urban areas. To be able to conduct the interviews with these participants the researcher had to stay in the nearest location in the village. Some of the villages have no electricity and therefore the data was collected on paper instead of a PC. The commuting was also difficult at times, as

the research was conducted during the June-July season when the flood isolates the villages. Commuting by local means of transport such as Rickshaws in those locations were the only option.

4.7.5 Mobile data collection

The process of obtaining itemized mobile data for the participants was a time-intensive process. The researcher had to travel with the farmers from villages to the network provider office that is located close to the urban areas, where the participant had to apply to receive their itemized bills. The mobile phone operators then generated a printout of incoming and outgoing calls of these participants. The researcher then had to sit with the participants to sequentially go through the phone bills in order to identify the social and commercial contacts from the bills. Afterward, based on their review the different commercial and social contacts were separated.

4.8 Data quality

Data analysis was challenging when these different sources of data were jointly reviewed and consolidated for analysis. Combining these different types of data requires refinement of the data sets to be able express in qualitative forms where this combined analysis provides an enriched understanding about the influence of the mobile phone use by the farmers.

4.8.1 Qualitative analysis

For qualitative analysis, there is no universally agreed list of formulae that a researcher can choose from. In this research, the analysis of data was undertaken using the features that show the linkage of the use of mobile phones with different forms of resource/capital. Huberman & Miles (2002) elaborated on these aspects known as 'thematic' analysis, a subjective and interpretive approach based on the observation

and converting these elements to data (Boyatzis, 1998).This research utilized nine different cases, where these multiple case studies offered greater potential for explanation (Gable, 1994); and so the themes identified from the 'framework' have been utilized to construct the questionnaire for case studies has been utilized across the nine cases.

The key theories have been introduced earlier (section 3.2.4) through the discussion of the framework. How these theories are relevant to answer the fundamental research question has been discussed in the research approach section (section 4.2).The qualitative analysis was conducted based on the data collected through the case studies. The questionnaire for the case studies as described in section 4.2 has been divided based on the specific components. These qualitative data were gathered through the detailed questionnaire from the case study participants. The data were then analysed and explained through the theoretical elements related to the framework. In parallel to the survey data, the case study data also provides the rice farmers practices and preferences on using the mobile phone for commercial or social purposes. The other forms of data for the case studies such as mobility map and mobile phone data have been analysed to identify the social and commercial outreach of the case study participants and their social use of mobile phone. These three forms of data for provide a holistic understanding of the rice farmers' mobile use. The questionnaire provides information on their social network, and the content shared between social/commercial contacts. The other theoretical components such as choice, gender and structural dimension are discussed through responses from the case participants. These responses were later analysed in relation to the theories employed and explained earlier. The mobile phone data of the cases were analysed through the seasonal perspective, where the social and commercial uses of the mobile phone were discussed. The mobility map of the cases also provided the spatial distance of the participants social and commercial contacts.

Case studies and survey of the research provides the data required to be able to use the framework. However, the case studies require an analysis based on the framework components. The survey data along with statistical data that is analysed provides the contextual findings. These findings provide the logical conclusion about the presence of the process that allows the rice producers to access to capital and resources. This logical conclusion based on the qualitative data findings can be categorized as the deductive inferences for the research (King, et al., 1994). According King, deductive inference is useful to identify and subsequently conclude from a specific research premise. In the research, the data gathered from case studies and statistical analysis provides the theoretical foundation for the research question. The qualitative analysis of the case studies provides the foundation on the structural and agential influences on the process of using the mobile phone. The farmers' interpretations and explanations about their use of mobile phone for communicating with the social and commercial contacts are utilized in the framework. The data from the case studies to be utilized in the framework is dependent on the qualitative analysis.

Multiple-case analysis: In comparison with a single case the multiple cases has a better analytical possibility. In a single case, there is the purpose of explaining the situation and distinguishing the problem of the case but in multiple case studies, the difference between the cases allows the research to recognize the core knowledge that emerges from the difference or comparison between the cases (Baxter & Jack, 2008). In the multiple case analysis, experiences of the nine cases are explained components of the framework and concepts derived from the literature.

4.8.2 Statistical analysis

Based on the framework requirements, the overall methodological outline and data sampling for the statistical analysis have several implications. The data that is designed to explain a certain aspect of the research can be referred as the subject of

the research design. In this research, the overall data such as age, gender, etc. are the subject that explains an element of the socio-technical capacity. This data is to be sampled from the chosen population for parametric statistics for the analysis. The research also requires opinions and preferences from the rice producers for the use of mobile phones, that are non-parametric statistics that are not required to fit the normal distribution (Aldridge, 2001). The use of Likert scale data on the opinion of the farmers is utilized to analyze based on a composite score.

The data analysis also provides the descriptive statistics of the sample, where the population means and the descriptive statistics of the independent data provides a theoretical basis for the research. In the research the number of commercial contracts, age, number of social contacts and other such independent data provides the overall picture of the phenomenon. The central tendency in the frequency distribution of the sample produces the average of the data set.

In this research, the descriptive statistics have been utilized to provide the characteristics of individuals, groups or situations for the further analysis of the survey data. The overall aim is to describe the actual use of mobile phones for commercial purposes from a representative sample and determine the frequency that occurs). The frequency and percentage of the mobile use by the rice producers for commercial purposes was shown. This data also determines the relationship between different conceptual parameters that have been mentioned in the earlier section. The statistical data has also been utilized to learn about the age, gender, education, commercial contacts/social contacts and other parameters related to the commercial use of mobile phone.

However, to compare between the frequencies of data the descriptive statistics is not enough. The use of contingency tables (cross-tabulation) will be utilized to compare between variables in order to be able to indicate the relationships between the

variables in this research. This comparison will provide the important associations between variables such as age and the use of mobile phones, that will provide information about the existence of relationship between the variables. Chi-squared tests are to be applied that explain the variations between the cross-tabulated data, to determine whether differences are statistically meaningful. The series in the chi-squared test uses P=0.05 as the limit of significance, values below which are considered to be significant (Abbott & McKinney, 2013).

The other statistical technique that will be utilized to present the relationship between variables is the box-plot. Box-plots show the observations in the batch that are presented by the width of the box. The notches of the box are the difference between the batches. The box plot shows the maximum and minimum values in a range the upper lower and median quartiles. The interior of the box represents the distribution of the population. The lines which are also referred to as whiskers are the outliers of the data set that includes the minimum and maximum of the data set. The box plot is a concise representation of the data set that shows important characteristics of the data (Potter, et al., 2006).

4.9 Data quality

The purpose of this mixed method is to provide a greater confidence in the research. The case studies in this research provide 'particularization' (Stake, 1995) on the specific aspects in this research. On the other hand, statistical implications provide the generalizability of the research. The comparison of the statistical data with the secondary data collected from various government sources also strengthens the research data. The following steps have been adopted to ensure the desired research quality.

4.9.1 Survey Data

In order to assure representativeness, the survey data has been collected from ten different districts, which allows a wide variety of ethnic groups, religious groups and genders despite coming from the same profession.

4.9.2 Observation and in-depth interview

The researcher spent three days on each case study site. While the interview took place on the site, there were several meetings that took place on the same day with the local agro product suppliers and distributers to verify and triangulate the data gathered from the farmers.

4.9.3 Ethical Considerations

This research as described in the methodology section utilizes both primary and secondary data for analysis. Because of the sensitive data involved, informed consent was not presumed; rather accessing the data through the users ensured it. Therefore, it does not violate the contract made between subjects and the primary researchers (Hinds, et al., 1997). This is to ensure the professional guidelines on ethical practices discussed as guidelines for researchers by the British Sociological Association (BSA, 2002) are followed. Secondary use of datasets of the mobile users was discussed with selected mobile users being given careful consideration by the researcher, especially with regard to presumed consent and the potential risk of disclosure of sensitive information.

For primary data, this proposal adheres to the key principles of ethical research. Throughout the research period, the research method was continually reviewed to ensure integrity and quality. When conducting the primary research, participants involved in the interview process were provided with adequate information regarding the nature of the proposal and how the research procedures affect them, with their

informed consent obtained verbally and in writing to ensure their confidentiality and willingness to participate.

4.10 Chapter summary

The chapter elaborated the rationale for the research design and choosing the methodology techniques. The chapter also outlined data gathering technique methods in relation to the theoretical foundations explained in the earlier chapter. The chapter also provided a detailed account of the site selection, participants' selection and how the actual research has been conducted. The following table summarizes and explains the theories in relation to the research design.

Method and strategy	Purpose	Focus	Method of data collection	Method of data analysis
Case study	To understand how the rice growers, use the mobile phones and to observe the actual connection with their commercial capital creation	The case study from nine participants from two sites	In-depth interview with the participants, other interviews with related people, demographic information	Interpretation of data using thematic data analysis
Survey Methods; Descriptive statistics	To understand how the different indicators of commercial capital vary from a wide pool of participants and how the other indicators such as demographic info impacts the use of the mobile phone	The six hundred subjects' data from ten different districts has been collected	The survey was conducted on the six hundred respondents	The data has been analysed utilizing descriptive statistics
Social network analysis	To understand the actual use of the mobile phone and the duration and frequency of mobile phone use for commercial and non-commercial purposes	The nine itemized bills for the participants of the case study have been collected for two seasons	The mobile itemized bill for two agricultural seasons, harvesting season and land preparation season, have been collected for the selected participants	The social network map has been constructed from the case study analysis.

Table 4.4 - Theories and Research design

5. Findings & Interpretations
Part 1

5.1 Introduction

The results section is divided into two parts (Chapter 5 and 6). The first part (Chapter 5) presents data on two major aspects of the framework - structural and agential dimensions.

The agential dimension presents the findings related to agency influences and choice of the participants. The agency influences present the descriptive statistics of the rice producers' age, education, and gender-related data and their interpretations. The survey data related to choice has been discussed along with the relevant section from the cases that focuses on the participants' opinion on their choice of using mobile phones. The section discusses on data related to trust and geographic location of the rice producer.

The second section of this chapter discusses the structural dimension. The data on the structural dimension of the rice producers incorporates the social, commercial contacts created by the rice producers. This section comprises the rice producers' social connectivity, commercial practices and their knowledge creation through using a mobile phone. The case studies present the social network analysis maps and the communication patterns of the rice farmers. The institutional influence of the rice farmers is also elaborated in this section.

5.2 Agential Dimension

The agential dimension comprises of the farmers' agency influences such as age, gender and education. These three elements influence how the rice producers use the mobile phones for commercial purposes. The survey data on the participants' age and education has been compared with their number of commercial contacts and their communications to explain the relationships between these variables. The case studies on the other hand, provides the in-depth understanding and explanation of the preferences of the network creation and their reflection of their mobile phone use, patterns, and socio/commercial contacts.

Socio-demography influences, which have been categorized as agency-impacts directly impact the rice producers' actions and decisions. The socio-demographic indicators such as age, education and gender have a variable effect on the rice farmers. These influences ultimately impact the preferences of the individuals. The 'perception' which is also an important cognitive aspect a rice producer's significant influence of mobile telephony for commercial usage. Particularly, in agriculture 'knowledge' also plays a vital role among rice growers. In the following section, the agency influence has been discussed reflecting on the empirical findings.

5.2.1 Age

In the methodology section, the national statistics of Bangladesh shows farmer's age group between 20-64 (BBS, 2011). Rice farming in the rural areas of Bangladesh has been adopted as a profession by generations. In the case studies, it is evident from the participants that the farmers have their family, extended family in the rice farming business. Since it is a family profession, there are young family members who are involved in the agricultural activities and elderly members of the family involved in various capacities. However, the actual responsibility lies with the adult

members of the family who are responsible for the decision-making process of the farming activities in the household.

Regarding age, most of the respondents were between 21-50 years old (70.2%), followed by the age group between 60-80 years (10%) and between 21-34 years (25.8%). In an example of wellbeing, Sen mentioned how the possession of a bicycle does not benefit the owner if it is not being utilized to add to the owner's wellbeing (Townsend, 1985). Similarly, the possession of mobile phones does not dictate the social, commercial contacts created by the user irrespective of their age. The following box-plot represents the survey research conducted on the farmers' age and their preferred ways of communications, in order to explore the way in which rice producers utilize mobile phone for their commercial wellbeing.

Descriptive Statistics

N (Sample Size)		600
Mean		44.25
Variance		153.528
Range		59
Percentiles (calculated from grouped data)	25	33.94
	50	44.62
	75	54.10

	Minimum	Maximum	Mean	Std. Deviation
Age	21	80	44.25	12.391

Table 5.1 – Age related statistics

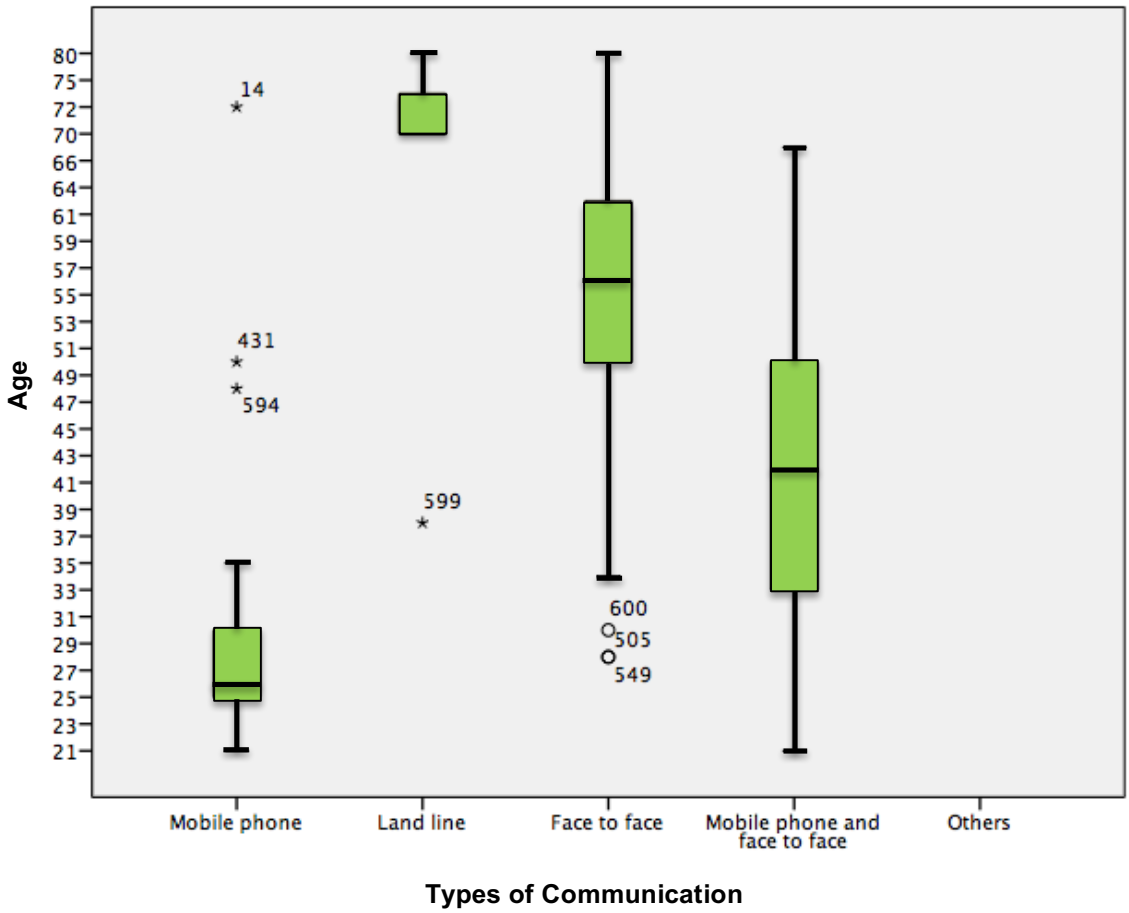


Figure 5.1A – Box plot depicting types of communication varying with age

The data shows a general tendency towards preferred communication media among different age groups of people. The graph shows that the farmers within the age group of 21 to 35 stated using a mobile phone to communicate with their commercial contacts. The farmers with the age group 49-64 preferred face to face communication. The age group of 35-50 preferred both mobile and face to face communication. Research conducted on over two thousand rice producers in Bangladesh by Asadullah, et al. (2014) showed that the average age of the farmers is 49 years. In this study, the average age of the farmers according to the findings is forty-four years. Therefore, the average age bracket of the rice producers is somewhere within 40-55 years. The age bracket among the participants, in this respect, provided a better representation of

the target population of this research - the rural rice producers, who are the decision-making adults in the household. The majority of the selected participants of this research are within 21-50 years (70%). Within the sample of six hundred people, there are farmers aged between 60-80 years (10%) who are involved in the rice production directly.

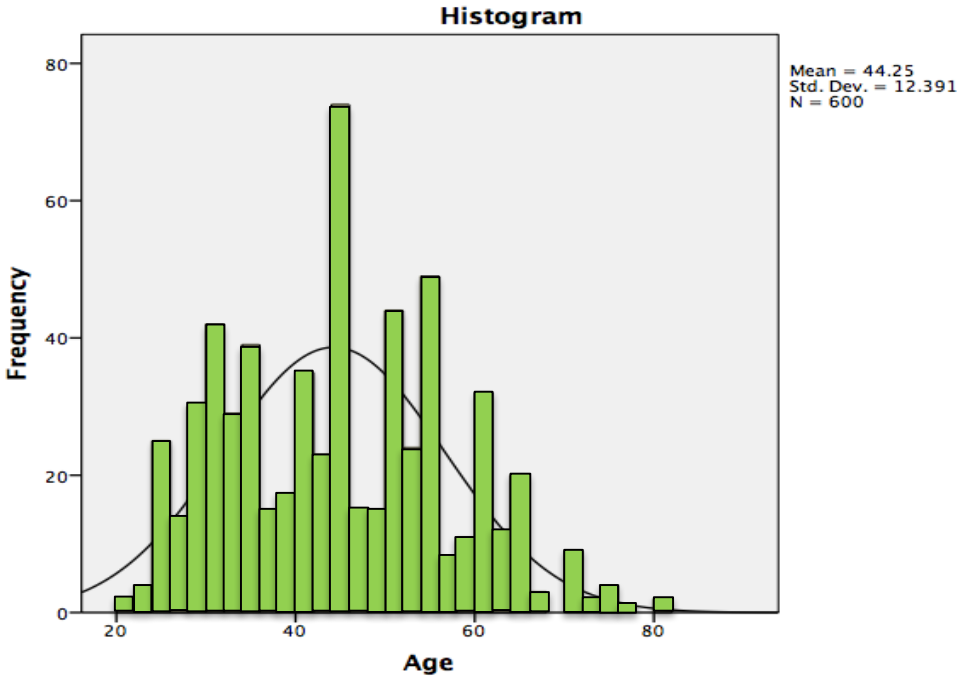


Figure 5.1B –Histogram depicting age of farmers and the frequency of mobile phone usage

A similar research on the farmers of Bangladesh and their adoption of the mobile phone showed 87% of farmers aged between 19-50 used mobile phones (Islam & Grönlund, 2011). This outcome of the research shows that the majority of farmers that use mobile phones fall between the ages twenty-one to fifty years old. Types of communication utilized to communicate with the commercial contacts in the empirical findings in the previous section showed the age group between 21-35 to prefer mobile phones to communicate with commercial contacts, compared to the 35-50 age group who prefer both face to face and mobile phones to communicate with their commercial

contacts. Within these two groups of participants, relatively younger rice producers are keener to take mobile telephony as the primary media of communication compared to the middle-aged and elderly group. Therefore, the younger group of people comparably keener to adopt technology differently than the middle-aged group. This variation reflects the societal practice despite their common professional interest.

5.2.2 Education

Regarding education, out of 600 of the participants, 96 completed primary level education which is 16 % of the total research sample size. The estimate from government censuses shows the total of primary education completed 19% (BBS, 2013) which varies from the data shown in this research by 3%. The possible cause for this variation is the inclusion of urban participants in the census. Whereas this research considers only the rural participants. According to the Bangladesh Bureau of Statistics, the total number of students from the eleventh grade to post-secondary education represents 16 % of the total population as of 2011 (BBS, 2013). The data collected for the research shows that 14 % of rice producers are within that bracket of eleventh standard to post-secondary education. 260 of the respondents had not received any formal education (43.3%). This indicates that 56% are literate in the sample size, which is representative of the actual state of education in Bangladesh, according to statistics published by the Ministry of Education the literacy rate of Bangladesh is 54% (BBS, 2013). The highest educated participants from the survey data were three individuals who completed their bachelor's degrees from the public university. These rice producers are among the land owners who have been involved in rice production for generations.

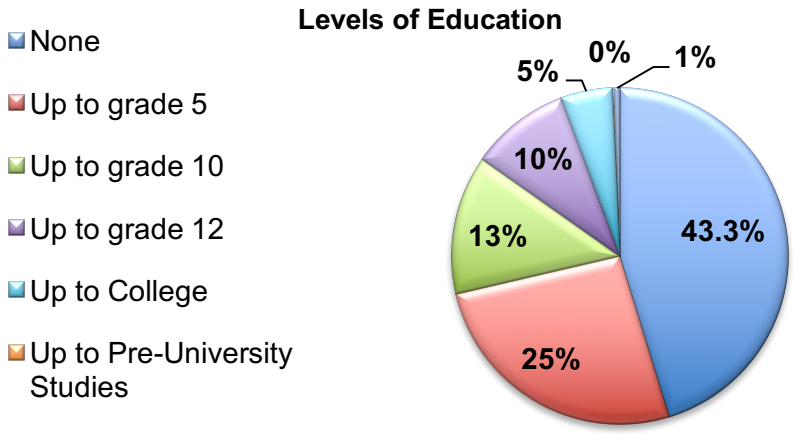


Figure 5.2 –The distribution of level of education amongst rice producers

From a mobile phone use perspective, there is a study conducted on the mobile users/owners and their age. The research drawing experience from Tanzania and Bangladesh showed over 60% of the mobile phone users have only primary education (Bairagi, et al., 2011). However, the author did not mention the mobile phone adoption by people who had no formal education. In addition, the author indicated low literacy rates and strong oral traditions as hindrances for ICT adoption. A research conducted among the Nigerian small and medium entrepreneurs showed that a low level of literacy has a negative impact on ICT adoption (Olatokun, 2007) .On the contrary to these researchers, fifty percent of the participants of this research who received no formal education showed an equal capability in using mobile phone. The participants with no formal education knew how to use mobile phones and remember the numbers of their commercial contacts by memorizing the last three or four digits. This knowledge has been referred to by (Maddox, 2009) as 'grass root literacy'. The research of grass root literacy was conducted in Bangladesh particularly in fishing communities. The researcher showed, that there are local fishermen, who had no formal education but knew how to count and keep records of the fishes. Their learning to count developed from the other fishermen and indicated learning to have no link with the external rules of standardization. The farmers, in this research who use mobile phones

have a similar type of 'grassroot literacy' on how to use mobile phones to communicate with the social/commercial contacts. The empirical findings show that the level of education does not have any significant impact on the choice of media of the rice producers. The case studies also showed how the selected farmers who range from being illiterate to being educated to primary level, use mobile phones according to their commercial needs, reflecting grassroots literacy where these farmers learned to adopt the technology to use in certain ways that benefit their commercialization.

Interviews with the participants showed that their surrounding influences impact their adoption and use of mobile phone more than their education. There is a psychological factor such as willingness to use the mobile phone to influence their use. Those who have been using mobile phones for many years, are proficient, and education is considered to play no role in influencing the nature of their use.

Among the participants, the self-efficacy and interest were the key drivers to use the mobile phones in particular, despite there being a lack of understanding of all the functions of the mobile phones. Some participant rice producers cannot efficiently use the mobile phones to store numbers due to their lack of education in English, which is the primary language of mobile user interfaces. However, they can read and seek help from other farmers to store the numbers in their phones. This also shows how their dependencies on peers and social ties, influence to compensate for their illiteracy along with their adoption and use of mobile phones.

The very limited use of SMS (short messaging service) is also very specifically due to the lack of English language knowledge. The case participants in the research showed that they received SMS' from operators regarding the agricultural services but were unaware of those services because of their limitations in reading the message. Despite the participants showing their interest and capacity to quickly learn the basic

functionality of the mobile phones, their use is restricted to the voice to voice communication. Research by Islam & Grönlund (2011) in rural farmers in Bangladesh shows 70% of the farmers find it difficult to read SMS because of the difficulty in reading English.

5.2.3 Choice

The choice related data incorporates the importance, timeliness and data relevance for the rice producers. The section further discusses the case studies related to the farmers' choice, timeliness and relevance to mobile phone usage. The choice as explained earlier (section 3.2) refers to the freedom that enables to attain a perceived benefit by the user. These benefits as discussed in the section (3.2) depends on their desired outcome. Similarly, for the rice producers, the choice of using mobile phone has a varying degree of perceived commercial benefit in terms of importance, relevance and timeliness for their agricultural use.

Specific comparisons between indicators such as frequency of mobile phone usage, and how they find the information relevance is discussed in this section. The section is followed by the number of mobile phone contacts and the timeliness is also discussed. There are examples which show that the information from traders, collectors and buyers is vital for rice production activities. Among the respondents' 170 participants (28.3%) of the farmers mentioned that the information content shared with the commercial contacts is very important, and 166 respondents (27.7%) believed the contents shared to be 'important.' There were also 204 respondents (34%) who found the contents shared to be 'not so important.'

	Frequency	Percentage	Cumulative Percentage
Very Important	170	28.3	28.3
Important	166	27.7	56.0
No so Important	60	10.0	66.0
Not important	204	34.0	100.0
Total	600	100.0	

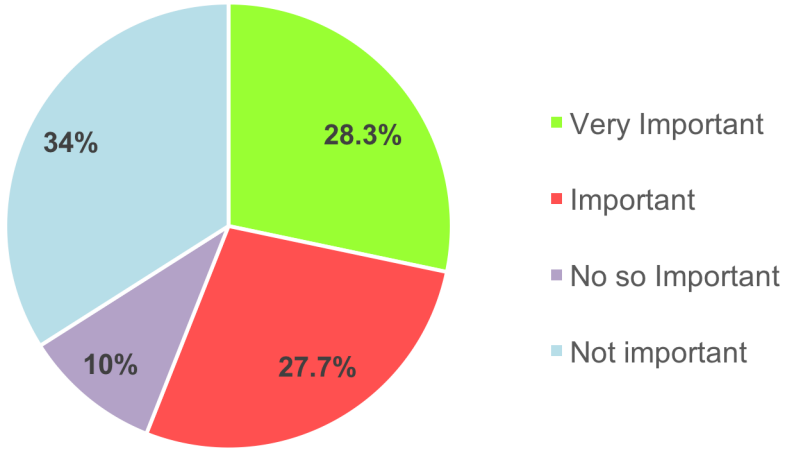


Figure 5.3 – Perceived importance of information content

The importance of information, such as commodity price, plays an efficient function for the rural rice producers. The rice producers characterize this efficacy of information as information relevance. According to the survey 261 of the respondents (43.4%) find the information useful for their commercial engagement compared to only 22 respondents (3.7%) who find the information not relevant at all.

	Frequency	Percentage	Cumulative Percentage
Not at all	22	3.7	3.7
Slightly relevant	82	13.7	17.3
Average	115	19.2	36.5
Relevant	261	43.5	80.0
Very relevant	120	20.0	100.0
Total	600	100.0	

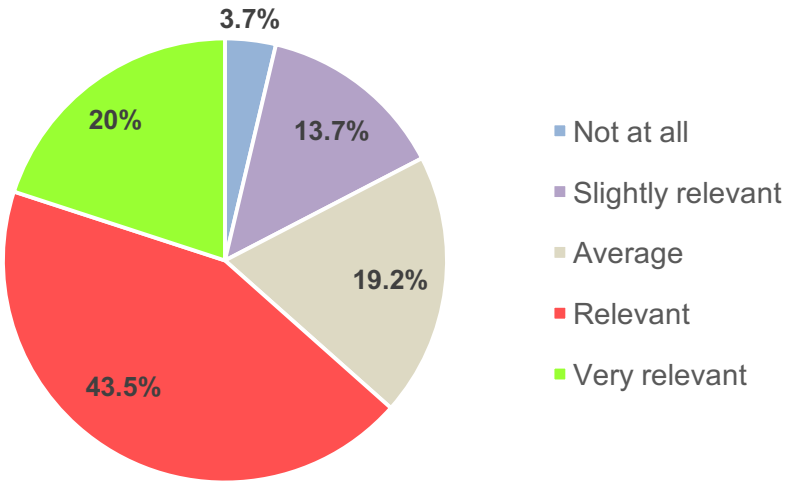


Figure 5.4 – Perceived relevance of information content

Referring to the research shown in the literature review, Jenson (2007) and Aker (2010) show that access to timely information through the use of mobile telephony benefits the rural traders. Therefore, information timeliness is a vital input for the rural rice growers. Among the respondents 44% of respondents found the information to be somewhat timely, and the closest 33% respondents finds the information almost always timely.

	Frequency	Percentage	Cumulative Percentage
Never	5	0.8	0.8
Rarely	67	11.2	12.0
Sometimes	228	38.0	50.0
Almost always	247	41.2	91.2
Always	53	8.8	100.0
Total	600	100.0	

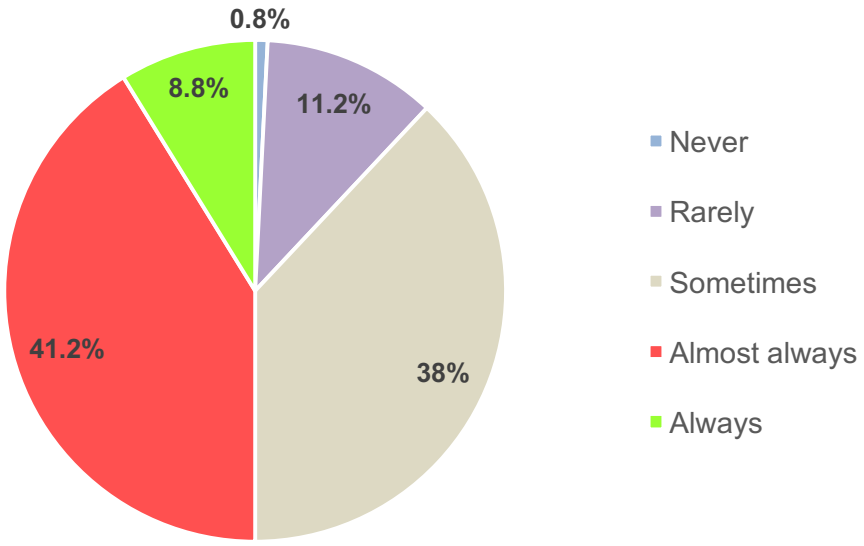


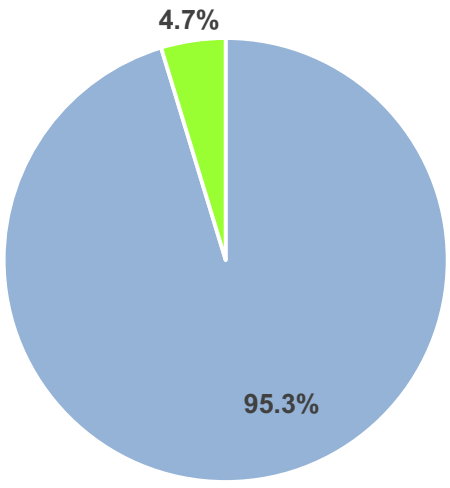
Figure 5.5 – Perceived timeliness of information

Communication, particularly in a rural area is a fundamental function of social interaction. Therefore, the role of communication can be perceived as an important influence on local commercial activities. The accessibility of information through communication is a prime benefit for the farmers. As a medium, the farmers use the mobile phone along with face-to-face communication. The survey research shows that 48% of farmers utilize both face-face and the mobile phone for communicating with their buyers and suppliers, compared to 26% of farmers that use face-to-face communicate with their buyers and suppliers. The selected participants used the

mobile phone for both social and commercial communication. As evident from the case studies, there are friends, family members or social contacts that surround the rice farmers in rural areas. Despite the proximity of the contacts, the farmers use other forms of media such as the mobile phone to communicate and extend their communication with people from distant places. Farmers' communication is also affected by the seasonality (section 2.3.7). There are broadly three seasons for the farmers. In the case study analysis, there are participants who provided their use of different types of media and the commercial advantage they receive through those media.

5.2.4 Gender

The study on village programs has mentioned that the use of mobile phones by women has the potential to boost income for the rural household, health care and agri-business (Bairagi, et al., 2011) .This accessibility has been referred as 'phone culture' where the women uses mobile to be able to communicate and connect with their social and commercial contacts. However, in the total sample of 600 participants, 572 (95%) were male and 28 (5%) were female.



	Frequency	Percentage
Male	572	95.3
Female	28	4.7
Total	600	100.0

Figure 5.6 – Gender related statistics

The females in this research are directly involved in the process of rice production. This low number of females in agricultural activities has been a topic of discussion in academia for a long time. Women, especially in developing countries are not involved in the land preparation and primarily participate rice preparation activities. Since the field level activities, such as sowing seeds and harvesting are physical labour intensive tasks, male members in the household are primarily involve in these processes, and female members are largely engaged in the post-harvest activities such as seed cleaning, selection and storing. However, there are also those women who do not work in a passive role in rice production. In this research, the women who work as full-time farmers actively work in the field and makes decision for their produce. Therefore, from a gender perspective, the use of mobile phones does not have an impact on the women who already have phones but are involved in a passive role in agriculture. The accessibility does not change her role. However, the only female farmer from the case study shows a total of eighty-seven contacts in her phone, of which thirty-five are commercial contacts. During the interview session, the female farmer (Mita, Case study number four) mentioned that the mobile phones are essential for her rice production because the support that she required for the cultivation is mostly coming from the close and distant family members. These members are not paid workers for the farmer. Therefore, she uses mobile phones to source the alternative helping hand during the cultivation, land preparation and harvesting season. Her Social Network Map is also evident of her mobile phone usage behaviour.

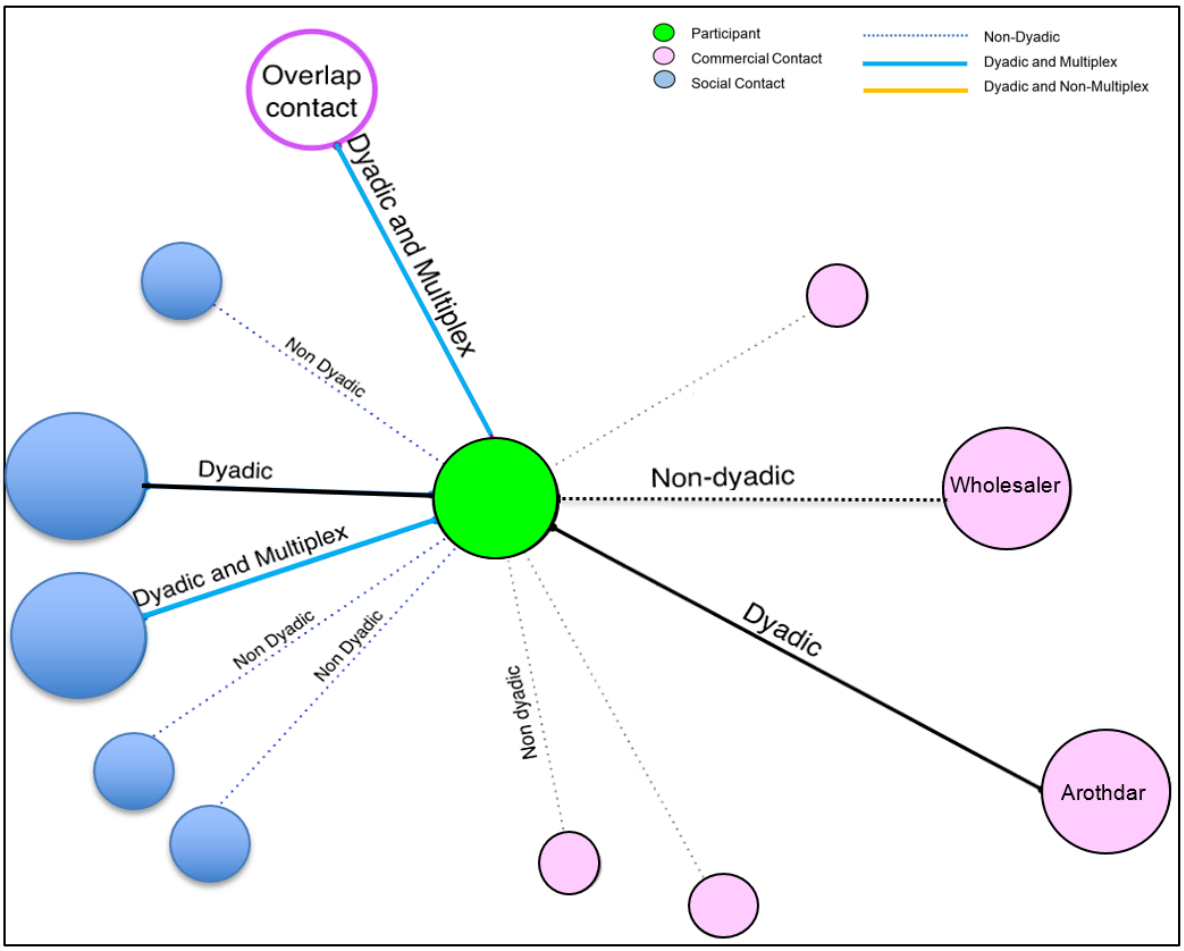


Figure 5.7 - SNA Map

Based on her SNA (social network analysis) map, she has both dyadic multiplex relationships with her social and overlap contacts. This indicates her commercial and social engagement with selected member of her family and distant family. Although she had commercial contacts in her mobile network, those contacts were mainly commercial in nature and there were no social exchanges with those contacts. Therefore, unlike male rice producers, the female rice producer did not create the social relationship with the commercial contacts. It is also indicative of the social norms and cultures that have been reflected in the adoption of using mobile phones by the female farmers.

The case studies and the survey show the female farmers are actively involved in the rice producers process. Although most of the participants in the research were male, the female participants in the research mentioned their involvement in the process of harvesting, post-harvesting activities, seed planting and uprooting seedling process. The majority of the female rice producers are not involved in the land preparation stage as it was done by the male members of the family. However, the female farmers were involved in the husking of the paddy, preparing the courtyard and manually separating grain from the stalk. The female farmers were also not preferred by the male member of the house to work in the field during the Aman season, because of the water in the field. The female rice producers mentioned using the mobile phone to primarily communicate with their family members. These influences of social practices are apparently the social restrictions that present women with limited choice to use the mobile phones to its full extent. These social and cultural influences are reflected in their mobile phone usage. Research on female engagement in agricultural in Bangladesh by Munmun, et al. (2015) showed that 97.5% of females are actively involved in the farming process which is similar to the case studies and survey participant of the research showed an active involvement in the production process despite their limitations of using mobile phone for commercial purposes like their male counterpart.

5.2.5 Trust

Research by Molony (2006) on Tanzania's rural enterprise showed that 'trust' plays a vital role when communicating with the commercial contacts. Trust is vital for the rural entrepreneurs to be able to utilize the information for their rice production. In terms of trusting the information, 56.5% respondents highly trust the information and 15% 'somewhat trust' the information.

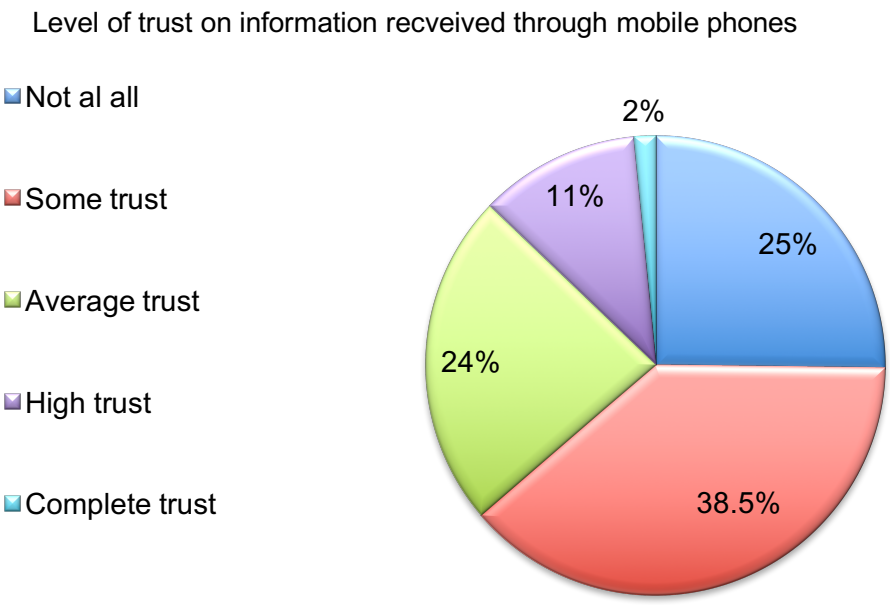


Figure 5.8 -Perceived trust

There is specific information related to trade and price that is associated with the commercial contacts the participant has. The box plot in this section comprises of the data collected from six hundred participants in the survey research. The data shows a trend between the number of commercial contacts and the level of 'trust' on the information received through mobile phone. The number of commercial contacts represents the decision and choice of the individual to have more contacts for their information need. As the number increases, the possibility to be able to communicate with relevant people for the commercial information increases. The comparisons between commercial contacts and level of trust in the empirical findings shows a noticeable positive relationship between the number of commercial contacts and the level of 'trust' in the information received through the mobile phones. The 'trust' as described earlier, is dependent on the cohesive social network created by the user, where the relationship with the contacts plays an important role.

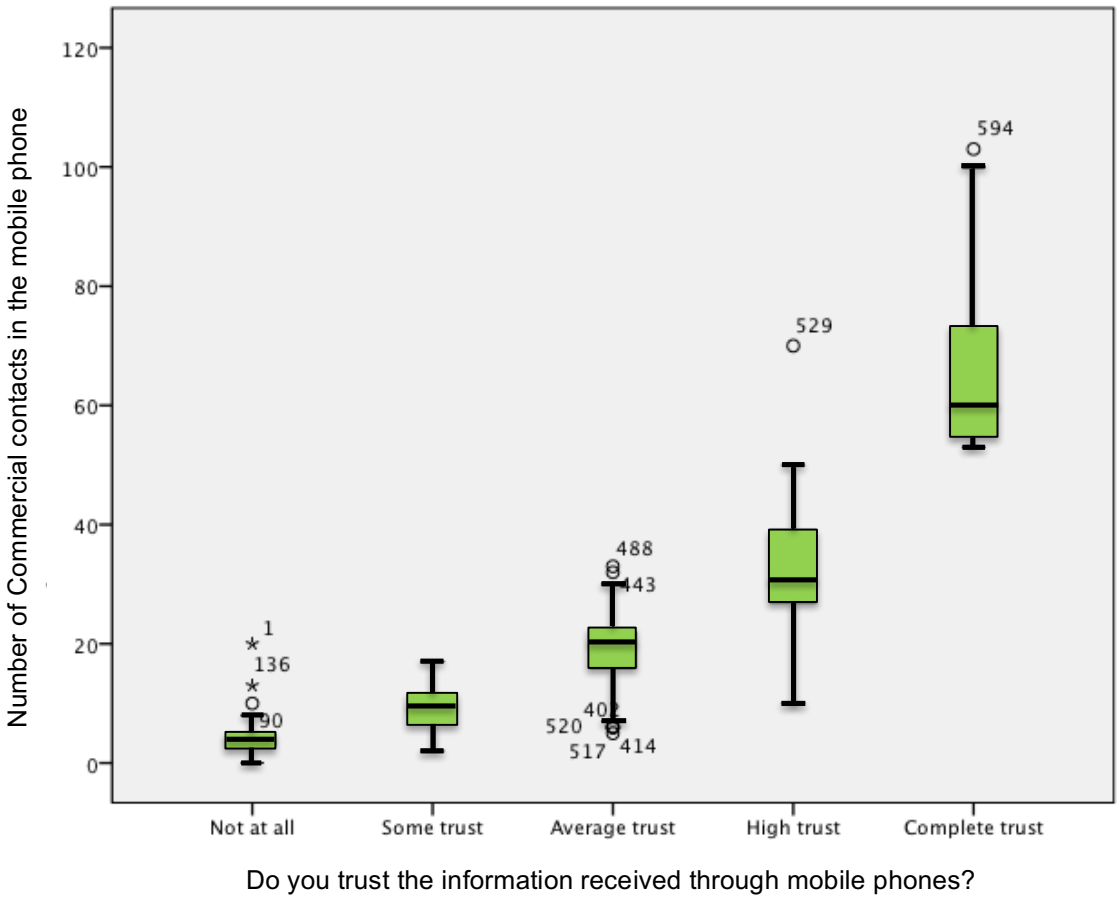


Figure 5.9 – Box-plot depicting the number of commercial contacts varying against level of trust

Trust as an agency influence plays a vital role in rural areas; especially because of the interrelated nature of informal institutions in rural areas as discussed in the literature review section. Rice producers obtain their information from the middlemen who are involved in the supply chain in the form of input suppliers, local buyers or credit providers. These individuals are familiar to the rice producers and are therefore perceived as trustworthy. Generally being from the same locality, these the core business of these contacts is reliant on familiarity and relationships.

The farmers using mobile phones perceive the benefits differently from one other in different manners. This varying perception is also dependent on whether the farmers consider mobile phones as a resource for their rice production. Therefore, how frequently they use the mobile phones depends on the benefit they perceive and the contacts they communicate with. In the survey data, the selected farmers were asked about their frequency of mobile phone usage (no. of times per day) and how relevant they found the data received through a mobile phone to be. This trust is fundamentally dependent on whether the rice producers choose to believe in the information they receive and how they rely on the other parties in the transaction.

5.2.6 Geo Location

The geo-location shows the spatial distance between the rice producer and his/her commercial contacts. This is particularly vital to understand the commercial impact of mobile telephony for the rice producers. With a mobile phone at his/her disposal, the communication with distant contacts was expected to be easier for the rural rice producers. It was found that, one hundred and thirty-eight respondents (23%), had their commercial contacts residing within 0.5 to 1 mile, with whom they communicated with through the mobile phones. The majority of the respondents, 361 (60.2%), had their commercial contacts within 1-3 miles.

	Frequency	Percentage	Cumulative Percentage
.5-1 Mile	138	23.0	23.0
1.1-3 Miles	361	60.2	83.2
3.1-5 Miles	73	12.2	95.3
Over 5 Miles	28	4.7	100.0
Total	600	100.0	

Table 5.2 -Geolocation related statistics

From a geographical point of view, the data shows that 49% of the commercial contacts are within 1 to 3 miles and 22% of the commercial contacts are within 3 to 5 miles.

	Frequency	Percentage
.5<1 Mile	120	20.0
1<3 Miles	293	48.8
3<5 Miles	131	21.8
5<9 Miles	42	7.0
9> Miles	14	2.3
Total	600	100.0

Table 5.3 – Distance to commercial contacts

The case study in the research shows the farmers use mobile phone to communicate with the people they are also in touch with through face to face communication. The farmer's mobility map in the following section shows how most of the rice producers in the case study have a limited spatial outreach. Although the use of mobile phones provides a possibility to reach out for the rice traders from distant villages or city, the rice producer utilizes the technology to communicate with people they are familiar with. These findings also indicate the effect on the transportation cost for the farmers. This data is consistent with the research conducted by the Asian Development Bank on 3,500 farmers from India and Bangladesh, gathered over five to ten years (Reardon, 2012).

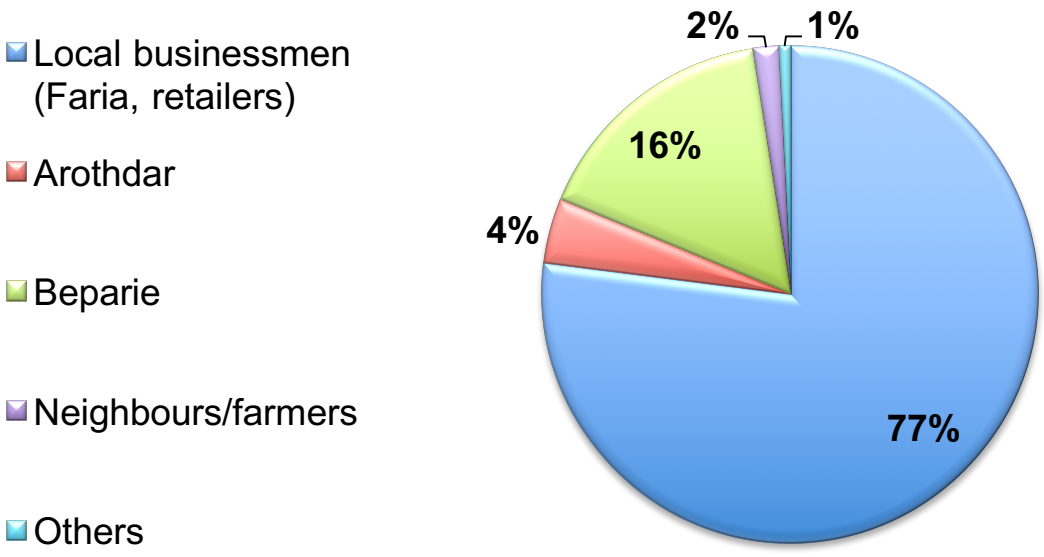


Figure 5.10 – Distribution of buyers from survey data

The findings suggested that the transportation cost is lower in Bangladesh because of the shorter supply chains for the farmer. According to the research, 60% of the commercial contacts of the rice producers are within 1.6 to 4 kilometres. Research by (Alam, et al., 2014) on the rice producers of Bangladesh shows three different figures based on the types of farmers. The research shows that for small farmers the distance to the nearest market is 1.44 kilometres, 1.73 kilometres for medium farmers and for all other farmers, 1.59 kilometres. According to the study, 83 % of all the buyers and sellers live within three miles (4.8 kilometres). The statistics showed by (Alam, et al., 2014) shows 92 % of total farmers to be from three districts, indicating that the market of the rice producers is within three kilometres. These data show the rice producers commercial distance. This short distance also includes the commercial contacts of the rice producers. Survey participants show that their network outreach is very limited despite the use of mobile phones. This data indicated the commercial practice of the rice producers that influence their mobile phone use that remains within a short geographic distance.

Farm type	Distance from nearest procurement centre (KM)	Distance from the nearest market (km)	Distance from nearest mill (km)
Marginal/small	5.44	1.44	1.66
Medium/Large	6.82	1.73	1.57
All Farm	6.15	1.59	1.69

Distance of nearest market from home (km)	District				All areas
	Mymensingh	Tangail	Dinajpur	Naogoan	
Up to 3	78 %	100%	96 %	85 %	92 %
4 – 7	21 %		4 %	8%	6 %
8 – 10				7 %	4%
Total	100%	100 %	100 %	100 %	100

Table 5.4 -Farm types and commercial distances, Alam et al (2014)

5.2.7 Land ownership

The earlier discussion on land (Section 2.3.5) shows that there are 26% marginal farmers, 44% small farmers and 21 % medium farmers (Rashid, et al., 2014) in Bangladesh. Alam, et al., (2014) shows that land ownership of the small farmers is on average 1.52 acres of lands, and medium to large farmers own between than 1.53 acres to 6 acres of lands. The findings of the study are aligned with this research, which shows that 26 % of the rice producers (marginal farmers) own 0.5 to 1.49 acres, and 40% of the farmers (small farmers) own land approximately 1.49 acres. The research also shows that a total of 17% rice producers own 1.50 – 2.50 acres of land and 40% own more than 2.50 acres of lands.

	Frequency	Percentage	Cumulative Percentage
<.5 Acres	84	14.0	14.0
.5-1.49 Acres	160	26.7	40.7
1.5-2.49 Acres	105	17.5	58.2
2.5 Acre or more	251	41.8	100.0
Total	600	100.0	

Table 5.5 – Land ownership (Rashid, et al., 2014)

This land holding also impacts the number of commercial contacts that the rice producers have in their mobile phones. The box-plot shows a trend between the size of land holding and the number of commercial contacts in the rice producers' phones. The survey with the rice producers shows that the farm size reflects the amount of required labourers, input suppliers, and buyers for their produce, which are linked to the individual farmers' levels of income. These factors are reflected in their commercial contact lists, and the income level of the rice producers influences their use of mobile phones. The survey participants who are medium size farmers have more income that allows them to invest in technologies such as mobile phones, TV, and radios. Particularly for the mobile phone, they are able to spend more on their mobile phone credits. Studies conducted in two districts of Bangladesh by Kafura, et al., (2016) also showed similar findings on the medium and large farmers in their capacity to use ICT more than small farmers.

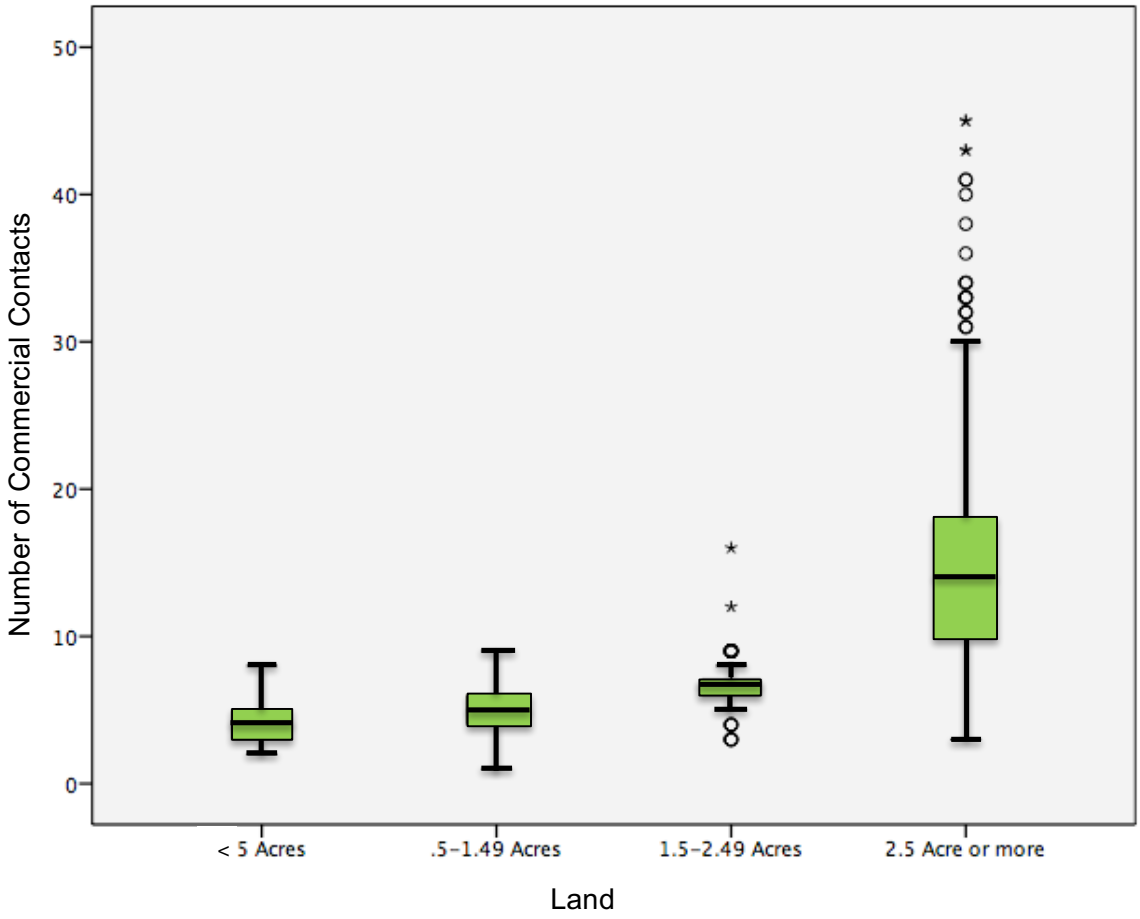


Figure 5.11 – Box-plot depicting the number of commercial contacts varying against land ownership

5.2.8 Key findings on socio-technical capacity

The socio-technical capacity indicates how the agency indicators influence their adoption of the mobile phones. The data shows that relatively younger farmers are keener to use the mobile phones for their commercial use compared to the older farmers. Regarding education, it was found that the limitation of education does not have an effect on their use of mobile phones, but it restricts extending their mobile phone usage to functions beyond voice to voice communication, such as SMS or internet services. The gender plays a role in farmers' use of mobile phones, where male

farmers use the mobile phones more extensively but the female farmers, despite working actively in the production process have limited use beyond social connectivity due to cultural influences. The geographic distance between the rice producers and their commercial contacts directly influences their spatial outreach of mobile phone use. The land ownership that indicates the income level of the farm also shows a direct impact on their commercial connectivity and overall mobile phone use.

5.3 Structural Dimension

The rice producers communicate with broad social and commercial contacts. This communication network with various institutions and individuals is implied as the 'structure' for the rice producers. The structural dimension elucidates the institutional influences which include the social/commercial networks and government organizations. The structural dimension also elaborates how the rice producer creates different types of networks. The social network map of the case study participants explains the basis of their social/commercial network building. The business conducted by using mobile phones is the local institutional practices of the rice producer. The knowledge creation by the rice producer explains how the rice producers use mobile phones for commercial purposes that indicate the structural dimension of the rice producer.

The institutional influence shows the commercial practices and norms of the rice producers. The trade-related knowledge creation by the farmers, and their commercial communications through mobile phones is vital input for the research. The rice producers' communication with the government officials and their individual stress on the commercial communications indicates the communications that are vital to their business. The case studies in this section provide insights into the different rice producers' opinion.

5.3.1 Social and Commercial Connections

Information, which is one of the key development inputs for the rural rice growers is obtained from various sources such as other farmers, government-agencies, input suppliers, etc. Therefore, the social and commercial contacts are vital to their rice producing activities. However, in this dataset, the number of contacts represents the total number of contacts the individual rice producer has on his or her mobile phone. The lowest number of contacts the rice producers have in this data set is eleven, and highest number being three hundred and seventy-four. The rice farmer with the higher number usually has a separate contact list in a diary – many of which are gathered over a period of time. The rice producers are not using many of the contacts in the lists. The total number of contacts in their mobile phone has three different types of contacts, social contacts that consist of the people whom the rice growers are socially attached to, such as the neighbours, friends, family, extended families and other types of social acquaintances. The commercial contacts consist of the people who are related to the rice producers for commercial/trade-related capacities, such as seed/fertilizer suppliers, government extension agents, wholesalers, traders and transporters, etc. There are also socio-commercial contacts or 'overlaps' who belong in both social and commercial spheres, such as family members who are also involved with the rice production with the respondents.

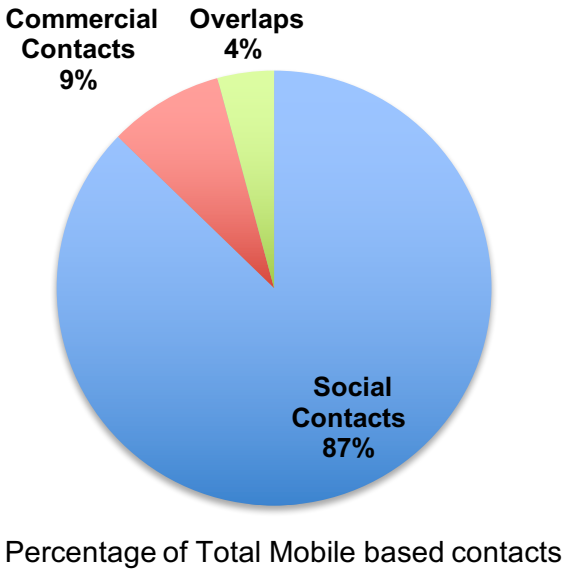


Figure 5.12 – Distribution of contact types

5.3.2 Commercial contacts through mobile phone

Mobile phone technology allows the rural rice producers to be able to communicate with each other and share information regarding different issues. In the sample size of six hundred participants, 18 respondents (3%) solely utilized mobile phones as communication medium to communicate with their buyers and suppliers. One hundred and six participants (18%) preferred face-to-face communication with their buyers and suppliers. However, a large number of respondents (a total of 475) utilized both mobile and face-to-face communication to communicate with their buyers and suppliers.

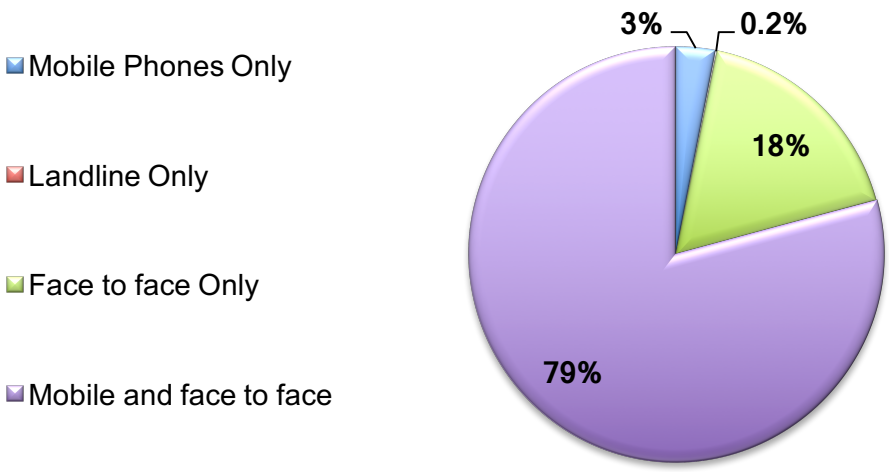


Figure 5.13 – Distribution of communication type

The 18 participants mentioned that they use solely mobile phones to communicate with their buyers and suppliers. These rice producers use distant market buyers with whom they communicate with regularly. These participants also buy their inputs from the local sellers whom they communicate with regularly. According to these farmers, they don't require to meet them face to face as the quantity of inputs they require and the volume of produce they sell is pre-arranged with the buyers and suppliers. There are one hundred and six participants that prefers face to face communication for commercial contacts. According to these contacts the input suppliers and the buyers are not far away and easily physically reachable.

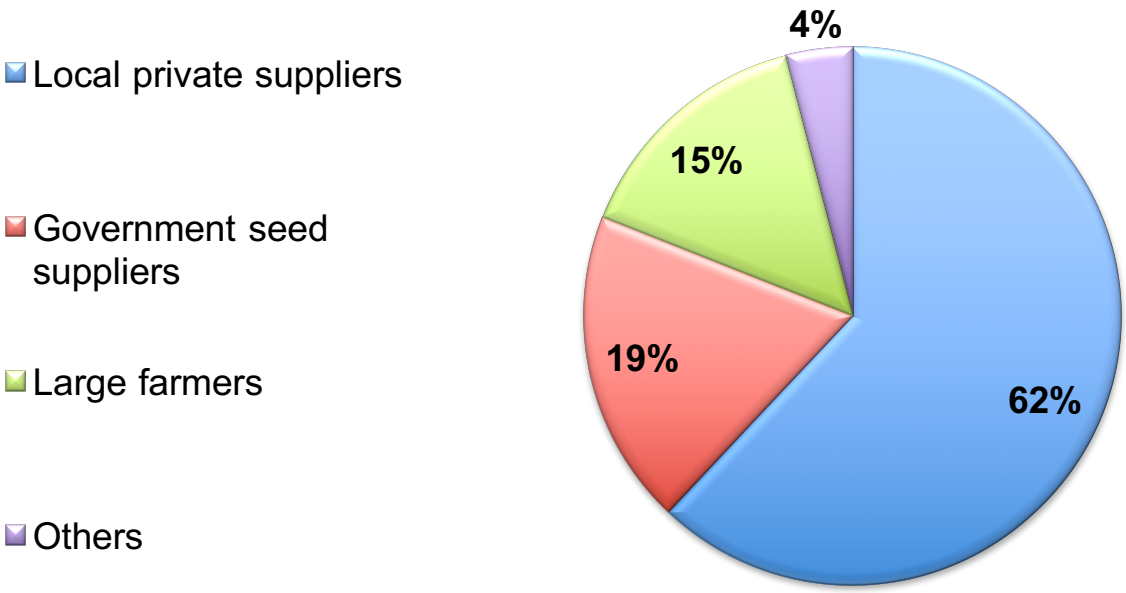


Figure 5.14 – Distribution of suppliers from survey data

According to these farmers, they use the mobile phones to communicate with the commercial contacts, and commute when face-to-face communication is preferable to these participants. The majority of the respondent (475) use both face-to-face and mobile phone for communicating with the commercial contacts. According to them, the commercial contacts are located in their nearby market and the participants interacts with these them on a regular basis, for social reasons, as well as commercial ones. Therefore, the communication with these contacts happen both face-to-face and through the mobile phones. There are also occasions where the face-to-face communication becomes essential such as for monetary transactions or the delivery of the produce to the buyers. The participants also mentioned that for price negotiations, they preferred face-to-face communication over the mobile phone.

The majority of contacts in the mobile phones of the rice producers are social contacts. The survey participants mentioned that their communication with social contacts were not purely social, but they also discussed matters of a commercial nature, such as the

exchange information regarding their seeds, fertilizers and commercial engagement with other contacts. These networks are based on their family ties, religious and professional commonalities and friendship. The networks of the rice producers vary based on their types of interactions discussed earlier (section 2.2.2, 2.2.3). The importance and presence of the social networks are also mentioned by Dey et al. (2015) where it shows the farmers discuss financial and agricultural issues with family and friends and the social network is an integral part of rural Bangladesh. The presence of social networks is also shown to influence the rice producers' choice in rice production technology, as demonstrated in research by Ward & Pede (2015) that conducted research on 2600 household in Bangladesh and showed how the social ties influence rice producers in choosing hybrid rice for cultivation. This data indicates that the communication practices of the rice producers is influenced by the presence of well-knit social environment where the rice producers are mostly connected with the social and commercial ties who are closely situated.

5.3.3 Mapping Social and Commercial Contacts

This section highlights the contact maps, which show the communication outreach, in terms of how far the rice producers communicate using mobile phones in kilometres, based on the mobility map (appendix 4) of the individual cases. The individual cases have been presented in chronological order to provide the individual's account for the geographic distance and the impact on their commercial/social communication. The individual maps provided a broad overview of their social and commercial network. The case studies provided a detailed picture of their communication map that provides the outreach radius of their communication. The nature of their communication provides the detail of social and commercial contacts and the number of contacts these case individual participants have on their mobile phones. The cases show a typical rice producer's mobile network has both social and commercial contacts. Their social

and commercial contacts are mostly their family friends, input suppliers, and buyers. Some of the key findings in these cases are:

1. Social contacts live within 1-3 kilometres.
2. Relatives, family members, and mainly trade partner live at a distance of 4-7 kilometres.
3. Rice producers use the mobile phone to communicate with the government extension agents.
4. Farmers mostly use the nearest market for commercial contacts, rarely communicate commercial contacts from the distant market.
5. The rice producers prefer both face-to-face and mobile communication with the contacts lives within 1-3 kilometres.
6. The spatial distance of mobile phone communication is very limited from geographic perspective.

5.3.4 Frequency of Communication

In the following section, the frequency of communication shows how frequently farmers utilize a mobile phone to communicate with their commercial contacts. A majority of hundred and ninety-seven (32.8%) rice producers use a mobile phone within every two days to communicate with their commercial contacts. The number of rice producers who use the mobile phones every day is one hundred seventy-four respondents (29%) compared to hundred and four respondents (17.3%) who use the mobile phone every three days.

Number of days	Frequency	Percentage
1	174	29.0
2	197	32.8
3	104	17.3
4	35	5.8
5	42	7.0
6	16	2.7
7	25	4.2
8	5	.8
9	1	.2
10	1	.2
Total	600	100.0

Table 5.6 – Frequency of communication

In the survey, the rice producers discussed their communication with the commercial contacts. According to the rice farmers the rice production process with three cycles (Aus, Aman, and Boro) rice production there is always need to communicate with the seed, fertilizer suppliers. According to the participants, the communication is mostly about the appropriate fertilizer and seed information. Therefore, there is a high frequency of communication with the input suppliers. The buyers on the other hand are communicated mainly in the harvesting season. There is also communication with

the laborers during the harvesting season. According to the participants, there is also local input sellers also provide valuable information regarding the use of the fertilizers and general farming techniques. This indicates the input suppliers are a major source of commercial information for the rice producers. Research conducted by Thorpe & Reed (2016) in the Rangpur region of Bangladesh shows 20% of the retailers serve 200,000 to 350,000 of farmers who are trained with agricultural knowledge by Catalyst (UK funded organization) to support rural farmers.

Number of overlap contacts

Among the participants, 94 respondents (15.7%) had three overlap contacts. The maximum number of overlap contacts was thirty-seven from of the rice producer, and lowest is zero among twenty-nine rice producers (4.8%). In the following chart it shows the percentage of these overlaps of the farmers.

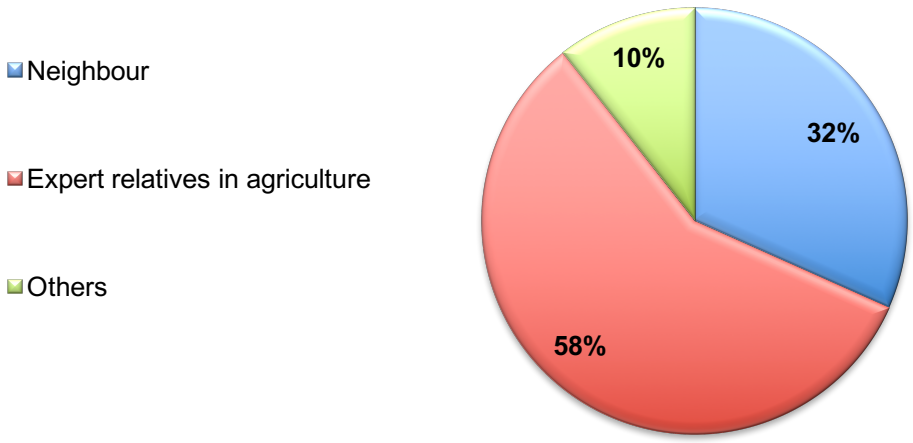


Figure 5.15 -Distribution of overlap contacts

The overlap contacts are the contacts whom the participants consider as both social and commercial contacts. These groups of people were difficult to isolate regarding receiving commercial information because the rice producers receive commercial

information from family members who are helping them in their farming. There are also commercial contacts with whom the rice producers create dyadic relationships. Therefore, the overlap contacts are among these groups with whom the participant have both social and commercial communication. According to the participants, 57% of the overlap contacts are family and friends who are directly involved in rice production process with the participants. According to the farmers, these are the family members such as cousins or relative with whom the participant jointly sell produce, buy inputs or own leased land for cropping. The participant communicates with these contacts for both social and commercial communications. There are 32 % of the overlap contacts who are neighbours. According to the participants, these neighbours who are also in the same profession help each other in the harvesting seasons. The 11% of these overall contacts are the family members of the participants who are involved in the agriculture trade such as family members who owns the input supply shop in the market place.

5.3.5 Case studies on the Commercial/Social communication exchange

The selected participants used a mobile phone for both social and commercial communication. As evident from the case studies, there are friends, family members or social contacts surround rice farmer in a rural area. Despite this proximity to the contacts, the farmers use other forms of media such as mobile phones to communicate and extend their communication with people from distant places. Farmers' communication was also affected by the seasonality (discussed in the literature review section). There are broadly three seasons for the farmers.

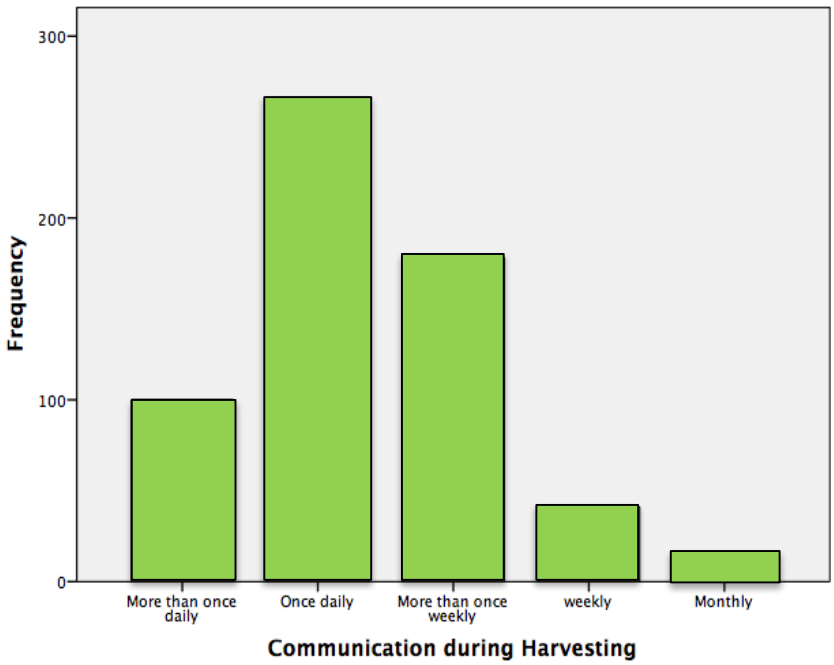


Figure 5.16 – Communication during harvesting

During the harvesting and land preparation phase, frequency of communication using a mobile phone is very similar in both. The majority of respondents use mobile phones daily, and there is a tendency towards calling at least once a day. The examples from case studies also reflect this mobile phone call behaviour. For the case study three, the distribution of mobile phone calls is shown below.

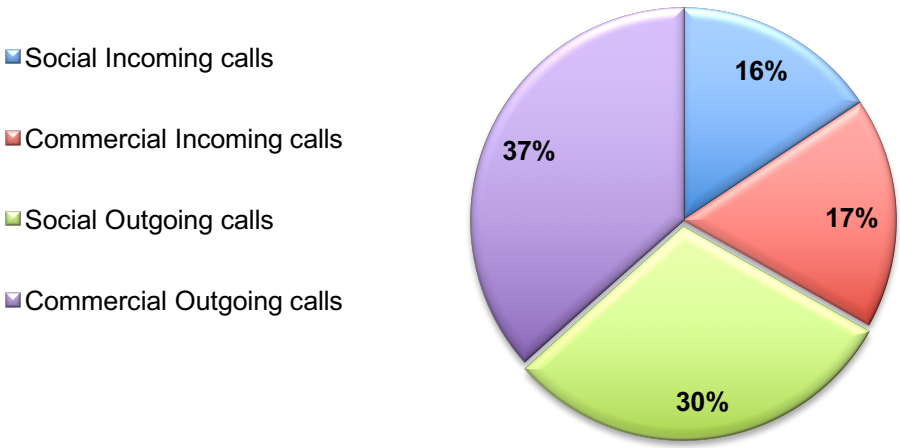


Figure 5.17 – Call type distribution during harvesting

Where the commercial outgoing and incoming calls bring up a total of 54%. depending Similar to this case, in other cases the commercial communication varies with season. On the other hand, during the pre-harvesting period, survey research shows the calling frequency distribution shown in the following histogram. These variations between the pre-harvesting and harvesting seasons indicates the participant's varying need of information and communication practice that differs based on their commercial activities.

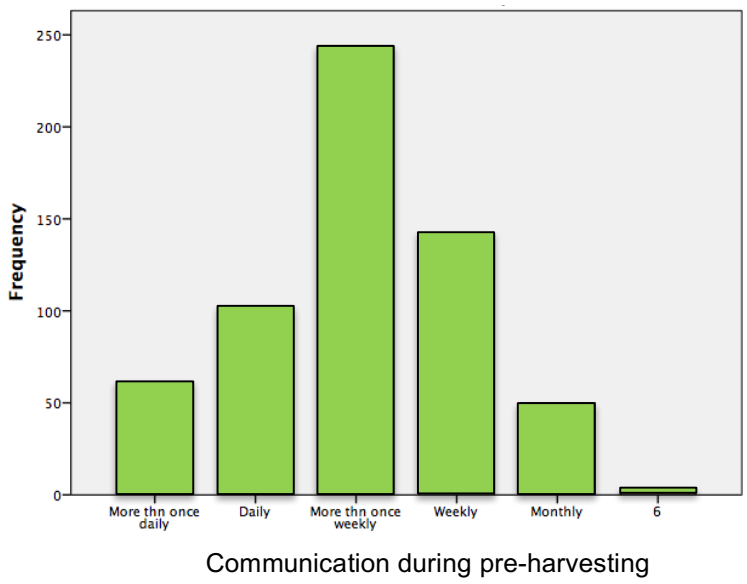


Figure 5.18 - Communication during pre-harvesting

From the bar chart the difference in the pre-harvesting period is visible. The majority of the users started calling from once a day to more than once a week. Therefore, the total phone call preference changed, compared to the lean season. For the same case study, the phone calls are as the following.

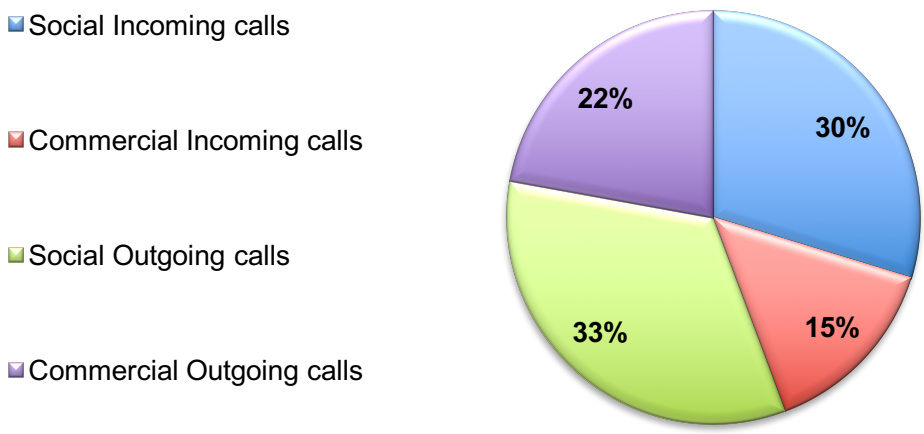


Figure 5.19 - Call type distribution during pre-harvesting

From the above pie-chart, it is visible that the total commercial communication went down to 37% compare to 54% in harvesting season, indicating that during the lean season the social communication increases. Therefore, the communication of the farmers' changes over time depend depending on their information requirements. As evident from the case studies, these changes are due to the farmers varying needs in different seasons. The choice of mobile phones plays a vital role in communicating with the social/ commercial contacts during these different phases of the rice production. The impact of the type of network that the farmer created also impacts when the communications take place.

The case study participant's mobile phone data has been gathered (to compare the seasonal variations of mobile phone usage between harvesting season and non-harvesting seasons. The call per day varies during three different phases; harvesting phase, land preparation phase and lean/between crop phase. Mobile phone data for the pre-harvesting time (June 2013, before Aus harvesting period), and harvesting time (July, 2013 Aus harvesting season) has been collected. Harvesting period involves the cutting, stacking, handling, threshing and cleaning of the produce. During the pre-

harvesting period the rice producers mainly spent time on crop health such as ensuring that there are no pests, disease or weeds. The physical activities involved hand weeding and pest management, based on accounts from the rice producers.

Key findings of the case studies of social/commercial exchange –

1. Participants' communication in the harvesting period increases due to necessary communication with the different buyers, mills, and transporters.
2. Participants' communication with the commercial contacts during pre-harvesting period primary includes the input suppliers for pest management.
3. The participants communicate with family, relatives and waged labour during the pre-harvesting time for support in their field.
4. The participants communicate more frequently during the pre-harvesting period with family and friends compare to the harvesting period.

5.3.6 Seasonal impact on communication

Rice producers require different types of information at different stages of their production cycles. These needs include pest management, disease management, produce prices, etc. Broadly, this cycle can be broken into to three segments-: land preparation phases, harvesting phases and between the cropping phases. During the *seed and plantation phase*, 230 participants (38.3%) communicated with their commercial contacts daily, compared to 22 respondents (3.7%) that communicate on a monthly basis.

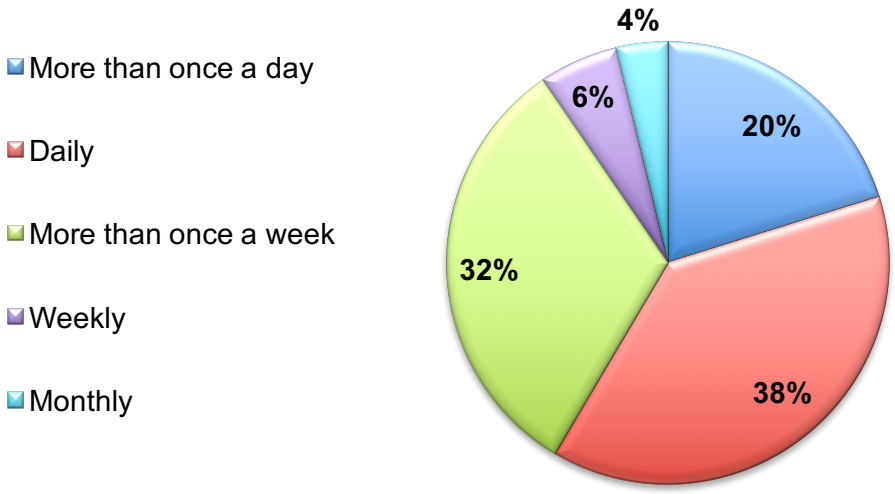


Figure 5.20 -Communication frequency during seeding and plantation

During the *communication between crops* phase, 244 (40.7%) respondents communicated with their commercial contacts weekly, compared to 102 respondents (17%) that communicated daily.

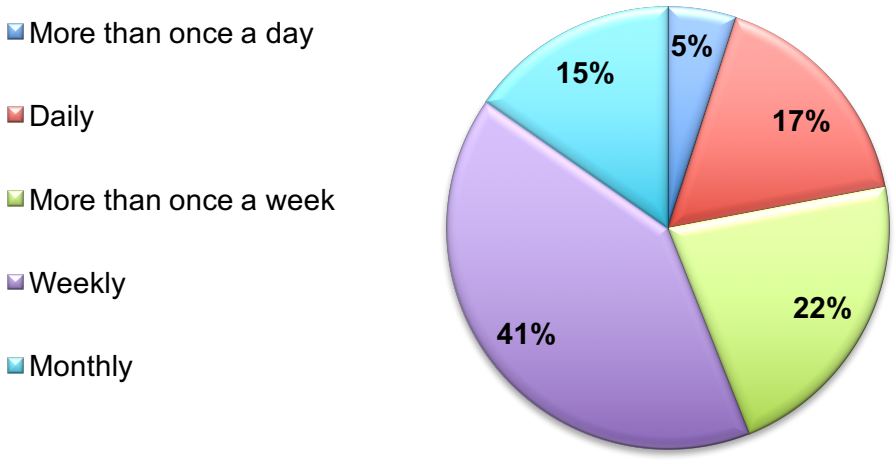


Figure 5.21 -Communication frequency between the crops phase

During the harvesting period, 266 participants (43%) communicated with their commercial contacts daily, compare to 15 participants (2.5%) on a monthly basis.

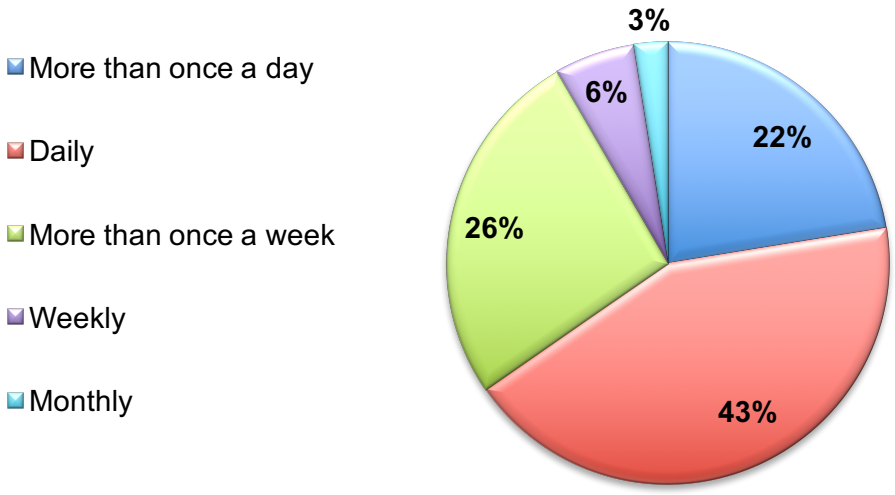


Figure 5.22 - Communication frequency during harvesting season

The participants showed different communication patterns in their usage during the harvesting and pre-harvesting period. The communications with the commercial contacts increased during harvesting period and that communication frequency shifts to social contacts during the pre-harvesting period. Therefore, there is a direct linkage with seasonality and communication for the rice producers.

5.3.7 Weak ties in the commercial network

According to the survey research, 60% of the participants communicated with their commercial contacts every two days. Among the respondents, 92% of the respondents communicated within five days. The frequency of communication with the network dictates the dyadic and non-dyadic relationships of the participants. The dyadic contacts are rooted in the wider social/commercial network that the farmers created. The interrelationship between these different contacts within the network varies depending on the strength of their relationship and the 'mutual dependency' (Burk, et al., 2007) .This dependency between the contacts is dependent on the importance

and impact perceived by the farmers. In the case studies, the impact of the dyadic and non-dyadic contacts through mobile phones has been discussed by creating the network maps for the individual cases. The case study one (Mr. Dipon) has dyadic social, commercial and socio-commercial contacts. The participant communicates more frequently with these dyadic contacts. Based on the network maps of the participants, the dyadic contacts also have multiplexity in their network natures. This nature of multiplexity or multiple associations with the dyadic contacts indicates that the participants benefit from the communication is primarily dependent on the dyadic contacts and their information exchange. These dyadic contacts with whom the participants have similar interests are prone to accept their opinion and feel trustworthy. The inter-exchange of communication between the dyadic contacts alleviate the potential for conflicts with the other contacts and strengthen their relationship (section 2.2.3).

In Case One, the participant also has access to a transporter through the dyadic contact that is vital to his rice production. In Case Two, the participant network map showed preferential mobile phone communication with dyadic contacts and communicate with non-dyadic relevant commercial contacts through the dyadic contacts. As an example from the case study, when the participant required any information from government extension agent, he communicated with his commercial contact that kept a regular interaction with the extension officer. In case three of the participant had several dyadic and non-dyadic contacts. According to the participant, a mobile phone as a medium has enabled him to communicate with commercial contacts that are not close-ties, yet important for the rice production. This importance by the farmers can be explained by following the pattern of adaptation of the behaviour and attitude of the contacts they are communicating with; dyadic or non-dyadic. In cases, where the non-dyadic contacts began to provide commercial benefit for the farmer (such as in Case Two), the non-dyadic contacts are perceived to be

particularly important. This change in the network, by partner selection is made possible by the influence of the characteristics of the contacts of the farmer, as the construction of an individual's social network and its behaviour dictates how the network evolves.

5.3.8 Knowledge creation using mobile telephony

Referring to the discussion on knowledge creation that benefits rural farmers by using mobile telephony, the knowledge creation goes through the process of educating the user about different functions of mobile phones, which increase the probability of making effective use of mobile phones. Information and communication technologies (ICTs), and especially mobiles, have the potential to reduce the information and knowledge gaps in agriculture value chains. For the survey research, a USAID-based study showed the rice producers refer to their knowledge based on six categories. The survey data shows the rice producers associate knowledge creations through mobile phone differently. A majority of two hundred and twenty-two participants (37%) mention the knowledge related to price, quantity and market has been acquired by using the mobile phone. In the following section these different types of knowledge creation have been elaborated.

	Frequency	Percentage
Trade related	29	4.8
Crop, Seed and fertilizer information	194	32.3
Price, quantity and market	222	37.0
Government information	58	9.7
Transport	94	15.7
	600	100.0

Table 5.7 – Perceived types of knowledge gained by the rice producers

Trade-related

Twenty-nine participants mentioned they acquired knowledge related to trade in general, such as knowledge about how to sell to any particular market or where to find buyers.

Crop, seed and fertilizer-related

One hundred and ninety-four participants (32.2%) participants acquired knowledge related to the crop, such as the type of crop to produce. For rural rice producers, the crop information is vital for their trade. Since there are many varieties of rice available for the farmers, they generally require information or knowledge about the variety of rice appropriate for their specific land. During land preparation, the farmers require information regarding their seed and fertilizer – which is a vital input for their rice production.

Price, quantity and market

The majority of participants acquired knowledge related to price, quantity and market which is vital for the farmers to make decisions on their production. The information or the knowledge related to the price of their produce, the quantity to sell and the market information, such as which market is providing a better price for their produce, is included.

Government information

Fifty-Eight participants (9.7%) acquired knowledge related to information provided by the government agencies, such as the department of agricultural extension. The information is related to subsidies, new crops and other government announcements.

Trade, product and transport

Ninety-four participants (15.4%) acquired knowledge related to transport, which is an important element in the rice production process. The farmers require knowledge of the available transport facilities to be able to transfer their produces to the buyers.

5.3.9 Types of business conducted using mobile telephony

The way in which knowledge has been utilized is dependent on their type of business that they conduct over the phones. The pilot study showed that the farmer conduct five types of trade using mobile telephony. These are price determination, information collection, trade-contract, buying and selling and related to price and business in general.

	Frequency	Percentage
Price Determination	96	16.0
Info collection	116	19.3
Business contract	73	12.2
Buying and selling	178	29.7
Others	35	5.8
Quantity and transport	102	17.0
	600	100.0

Table 5.8 – Commercial activities conducted through mobile phones

In the survey research, there were 178 respondents (29.7%) utilizing their phone for buying and selling. There are 116 respondents (19.3%) that utilize mobile phone for collecting information, and 102 respondents (17%) that utilize mobile phones for quantity and transport.

5.3.10 Case study findings on Institutional Practices

The individual cases explain how the farmers communicate and conduct business using the mobile phones; that represents the institutional practice for the rice producers. In the following section, these cases have been presented. The first participant was questioned about the increase of commercial contract from last year. According to the participant, there were two new commercial contacts added this year. These are the local Faria, who offered a better price in last year Aman season. So, the commercial network for the participant is a need-based response. Social contacts, however, are more open to more family and friends. When questioned about the types of buyers and sellers, the participant mentioned that the buyer group includes the local buyer, Faria and wholesaler from the market nearby. The suppliers of the participants are the local seed and fertilizer supplier and BADC (Bangladesh Agricultural Development Corporation). The mobile phone of the participant has both social and commercial contacts, and these contacts create the network that has both local people and people who live physically far away from the participant. These contacts that the participant communicates through mobile phone increase interactions and constructs social or commercial structure. There is a farmers' club to which the participant regularly goes; this club is a form of a social structure that provides valuable input for the farmer. Along with the clubs, the government agricultural ministry organizes other road shows and events that the participant takes part in. The club and the government extension agent keeps a directory of the phone numbers of the farmers to contact. Therefore, the communications from these different agencies form the commercial structure that the participants interact with. The second participant created a dyadic network that is crucial for his commercial and social linkages. Instead of communicating with the different parties such as a transporter by himself, the participant communicates through the dyad commercial contact. Although not directly, the participant communicates with the extended commercial contacts such as government agencies,

government seed suppliers, and wholesaler through the immediate contacts. Therefore, the 'structure' such as government agencies, or extended commercial contact such as wholesaler has rather an indirect influence on the participant. The third participant has commercial contacts that are not concentrated in any particular location. According to the participant, communicating with both social and commercial contacts helped him to encounter the individuals who became commercially beneficial contacts. Therefore, the particular wholesaler referred earlier, is commercially connected with the local suppliers. As the participant described, his produce does not have any transportation cost because the local suppliers take his goods as pre-arranged by the wholesaler from the nearest bazaar.

According to the participant, frequent communication with the government extension agent is also immensely beneficial. The department of agricultural extension provides various subsidies and supports for the farmers. The extension agent, as a local government representative plays a vital role in the process of farmer selection for the services provided by the government. As the participant is a close tie network to the extension officer, it benefits the participant to be able to get access to such government benefits. The forth-participant uses mobile telephony to access information from government extension agents and AIS, a government call centre for agricultural-related queries. The participant also seeks advice and support from family members who are involved in farming. The participant communicates with government and call centres to gather information in rice technology, so the information creation for the participant has a directly impacted by the mobile-based network that she created with these contacts. On the other hand, the participant communicates with male family members to help her in the field for which created a peer group to receive support during the harvesting and land preparation season. These arrangements created a structure for the participant to receive support in rice production. The fifth participant

believes social and commercial network creates a support structure for the participant. For the participant, this network that has both social and commercial contacts which create the source of information. Particularly from commercial network perspective, despite having the opportunity to be able to communicate with a greater number of commercial people, the participant communicates limits his communication to the selected commercial contacts to provide for his commercial information needs. As discussed in the previous section, the participant justifies his own preference to keep a limited number of commercial contacts as the peer group that he has his trust in. The sixth participant utilizes the mobile phone to interact with a diverse group of people. The participant communicates with government agencies, extension agent, government scientific research officer (DAE) and union officer. These contacts provide important input for the participant's rice production. The participant being the organizer of a farmer club, he communicates with local leaders such as the imam of the mosque. Therefore, the participant creates a support structure that is unique from the other participants. The participant's role as an organizer of a club influences his social and commercial communication pattern. The seventh participant regularly communicates with government extension agent and commercial contacts for trade. The network of the participant shows the participant prefers to communicate with a set number of people on a regular basis for any trade related information. Along with the commercial contacts, there are social contacts the individual communicate frequently that create a peer group for the participants. The eighth participant has both social and commercial contacts. However, the participant has strong social contacts. There are immediate and extended family members and friends on the contact lists the participant frequently communicate with. There is a presence of strong family institution or social structure in place for the participant. This social setting dictated how the participant utilized the mobile telephone. There are commercial contacts within the participant's contact list with whom relations were

sustained for a longer period; therefore, the commercial contacts also created a structure for the participant to operate keeping the contacts to a minimum number. The ninth participant contacts government agencies and communicates with buyers and suppliers from a distant market, which allows the participant to communicate with more traders. The relationship pattern shows a strong tie contact with the commercial contacts. The participant through these strong-tie commercial contacts created a strong commercial support structure. The participant also has dyadic social contacts that are the strong social peer group for the participant.

5.3.11 MPower farmer query system as a source of information

MPower farmer query system is an application specifically designed to support farmers with their queries related to crops, disease, pests, weather and cultivation technology (section 4.5). This is an example of a specialized agricultural service for the rice producers that is available to the farmers in Bangladesh. Research conducted by (Hasan, 2015) shows that out of 379 farmers chosen who use agricultural services, use them for the following requirements:

Types of Agricultural Information	Respondents	Percentage
Quality seeds & germination	50	13.19
Information Fertilization information	47	12.40
Pest control information	43	11.35
Uncomplicated cultivation	15	3.96
Information on Preservation of crops	17	4.49
Soil testing information	15	3.96
Irrigation and water management	40	10.55
Alternative cultivation	25	6.60

Table 5.9 – Agricultural information types required by farmers (Hasan, 2015)

The institutional practices broadly incorporate trade practices that rice producers adopt for their rice production. The MPower query system, which has been implemented for rice producers in certain regions of Bangladesh, provides the access to government information. Based on the ten cases collected from the MPower query

system, it can be seen that among various other information needs of the farmer, weed and pest related queries are prevalent. Receiving information on time is vital for the farmers, and the information required by the farmers also needs to be accurate. Through the MPower Query system, the farmers receive information from the local government extension agent-who is an expert in the local farming. The farmer query system also uses similar local networks that enables communication with the local government extension agents through the application. Therefore, the farmers can communicate with their local agents through a new medium, and the impact of the MPower farmer query system can be referred to as timely, relevant and important for their rice production. MPower cases of one hundred farmers show that of 16% farmers use a mobile phone for information related to pest and diseases. Another 18% of the farmers required information on the quality of seeds. There was also 15% information related to the fertilizers. The findings of the MPower cases also highlights the farmers' information requirements on market related information such as the price of grain in different cities. This information shows the growing impact of agricultural services that also creates a source of knowledge for the rice producers. The information call centres accessible through the application allows the rice producers to communicate with agricultural experts and this is a vital node in the commercial network of the rice producers that creates knowledge for them. MPower case examples can be found in the appendix section III.

5.3.12 Summary of structural dimension

The analysis of the structural dimension primarily explains the network types and the different sources of this information. The section provides the sources and the contacts that the participants contact to receive information. This also shows the institutional practices in terms of evident patterns on how and where the participants communicate and receive their information from. This pattern is the institutional practice that the

participants engage in to communicate with the social and commercial contacts that are broadly part of the rice production process.

The data analysis shows eighty-seven percent of the aggregate contacts of these participants are social contacts compared to nine percent which are commercial contacts. This shows that a larger proportion of contacts within the mobile phones of these participants are mainly social. However, this number varies in proportion from individual to individual. The farmers receive vital trade knowledge not only from the commercial contacts but also the social contacts. The relationships in the community with shared beliefs and profession are capable of organizing more resources for the individuals (Bebbington, et al., 2006).This indicates that the knowledge creation for the rice producers happens from both social and commercial contacts, where social contacts are the farmers that are involved in the same profession. Therefore, reflecting on the empirical findings, mobile phones enable the rice producers to gain access to the important and relevant local knowledge.

5.4 Chapter Summary

The chapter provided empirical findings and interpretations focusing on the components (agential and structural dimensions) discussed earlier in chapter three (section 3.6). From a structuration point of view, the interpretations provide insight on the extent to which the two components independently influence and impact rice producers' mobile phone use. The results also apply statistical inferences on the selected indicators from the survey data. The case studies, which have been presented in parallel with the statistical data, are provide some key explanations of those indicators, and provide further insight into the pattern of mobile phone use by the rice producers. The case studies also discuss the nature and scope of the rice producers' commercial engagement through mobile communication. In the following chapter the third element of the framework, the socio-technical provisioning is discussed.

6. Findings & Interpretations Part 2

6.1 Introduction

The second part of the results section discusses the socio-technical provisioning, which is the core component of the research framework. The earlier section discussed the agential and structural dimensions of the rice producers. These two elements represent two different dimensions of the framework. The agential dimension discussed the agency indicators such as age, education, and gender in relation to their use of mobile phones. The structural dimension represent the social and commercial contacts that the rice producers create by using the mobile phones. The intersection of these two factors, which is the sociotechnical provisioning is discussed in this chapter.

6.2 Socio-technical provisioning

In this section, the discussion explains the interrelationships between different indicators that build up the argument that shows how the rice producers are influenced by their agency attributes and the structural influences. The section is divided into two parts. The initial part discusses the rice producers' attributes and their relationship with the unique features of the mobile phones. The case studies of the research shed light on the rice producers' beliefs and decisions regarding their use of mobile phones for commercial purposes. Utilizing the survey data and comparing data on the number of contacts, frequency of communication, the relevance of information for the rice producers and 'timeliness' further elaborate this discussion by bringing the case studies and survey data together to show interrelationship between the elements. The second part of the socio-technical provisioning extends the discussion from the individuals' perspective to the external dimension, where the network and communication preferences have been discussed. The discussion includes the importance of commercial contents in relation to the increasing number of commercial contacts and the nature of business transactions of the rice producers.

6.3 Agential aspect of provisioning

Human agency, according to Giddens, is the “capacity to make a difference” (Giddens, 1984 pp 14), which he also calls ‘transformative capacity.' This agency can be denoted by the elements that have a rather ‘consequential significance in areas of decision-making or different stages in the decision-making process’ (Kabeer, 2012). The way in which rice producers use the mobile phones such as their communication behaviour, beliefs, and choices are examples of those elements. These attributes about their mobile phone use for commercial purposes have an underlying influence from their surroundings. However, the extent to which the individual preferences or choices impact their use of mobile phones are determined by comparing these indicators. In this section, a basis of their mobile phone preferences has been discussed by comparing the perception shared by the rice producers. The rice producers’ frequency of mobile phone usage and the number of contacts the rice producers will have on their phones indicates the choices made by them. The statistical analysis has a corresponding meaning attached by the user by expressing the timeliness, relevance or importance. These are the outcomes that the rice producers achieve by executing their choice of using mobile phones. Timeliness, relevance and importance can also be referred as the 'features' of the mobile phone as the rice producer achieves these three outcomes through the use of mobile phones. Therefore, there is a duality in the meaning of these three attributes; they represent both agency impacts and the unique features of the phones. The statistical comparison between the indicators provides insights into their relationships. The numerical analysis along with qualitative case studies provide the basis to establish the relationships between choice, agency influence, and the mobile features, which shape the agency led dimension of the provisioning.

6.3.1 Reflection of Choice in the case studies

The individual rice producers' behaviour, beliefs, and decisions regarding their communication preferences dictates rice farmers' use of mobile phones or selection of commercial/social contacts. The case studies in the research discuss the details of these attributes of the rice producers. In the case studies, the participants shared their different views on their communication behaviour. The implications of choice discussed earlier (section 3.2.1) introduced the three stages of choice; the existence of choice, use of choice and achieving the desired outcome of choice. In this section, the reflections of choice in the selected cases has been discussed to explore how the exercise of choice provides the desired outcome for the participants, and how they materialize to their desired outcome.

The results of the case study participants show how the user's desired outcome of choice of the mobile phone for relating to distant contacts and nearby friends has been met. The pre-harvesting and harvesting period calls of the participants shows that there is an increase in the commercial communication during the harvesting period which has a distinct commercial need and is a reflection of choice for the rice producers. The participants also mention 'peer' influence on the decision to adopt the use of a mobile phone. However, the decision to create the particular type of network links is by choice and 'habit.' According to the participants, he started to communicate with the individuals though the mobile in times of emergencies, as they believed it to be useful in such circumstances. The participant 'trusts' the information received through the mobile phone because the participant personally knows these people. Therefore, the trust is related to the familiarity with the individual. The participants believe these connections are essential for trade and social life. They keep a very close-tie relationship with a selected group of social and commercial contacts. According to the

participants, the mobile phone allows them to become visible to these selected group of people.

The rice producers' 'trust' (discussed in section 5.1.8) is related to their familiarity, which also plays a significant role in their communication with distant contacts.

Some key observations from the case studies

1. Participants uses the mobile phone to communicate with family members. Use of the mobile phone does not add anything different to the social exchange other than serving as a means to communicate more frequently.

2. According to the participants, the use of mobile phone enabled them to be able to communicate with people with whom they had no other way to communicate.

3. According to the participants, the commercial contacts are necessary for trade include seed suppliers, fertilizer suppliers, extension agents, wholesalers, transporters and market informers.

4. The use of the mobile phone, according to the participants is restricted to the close-tie network that they created. The participants consider the mobile phone as a device to strengthen the relationships; therefore, it is the indicates the existence of choice for the participant. The participants use the mobile to communicate and contact their network for any particular purpose that may be, this creates the sense of choice for the participant.

5. According to the participants, timeliness was the great advantage: mobile telephony allowed them to be able to communicate with his social/commercial contacts instantly. This sense of mobility is referring to the existence of choice

as mentioned in the framework described by Kleine (2010). Although the participants have a large number of commercial contacts, they chose certain individuals with whom they prefer to communicate when the need arises, which is the 'use of choice.'

6.3.2 Impact of choice and relevance of information on frequency

The use of the mobile phone is unequivocally categorized under some specific type of benefit perceived by the farmer as mentioned in the case studies shown in the previous section, such as useful in times of emergencies or communication with remote contacts. These benefits perceived by the farmers differ from each other. One indicator of their mobile phone use is the frequency of communication. The frequency of their communication shows how critical it is for the rice producers for their commercial engagement or social communication. But, how frequently they use mobile phones depends on the benefit they perceive and the contacts they communicate with. The previous section discussed the motivations of choice the rice producers make for communication. The survey conducted on the rice producers includes information on how frequently they use the mobile phones to communicate with their commercial contacts (on a scale of zero to ten days) and how relevant they find the information received through the mobile phone.

The participants use of mobile phones is impacted by several agencies influences (section 5.1). The impact of choice and its outcome (section 6.1) from the case studies indicates the commercial motives dictating the use of choice. The use of choice that is determined by the individuals' socio-technical capacity creates an impact on the structure when the rice producers engage with the commercial communication with the social and commercial network. The relevance of information has multiple meanings for the participants. It can be considered as an important feature of mobile phone as communication medium that enables access to relevant information for the

rice producers. The receiving of relevant information also indicates the commercial significance of mobile phones for the participants' commercial engagement. On the other hand, how frequently the participants use the mobile phones from a choice perspective indicates their use of choice to achieve the desired outcome.

In the following section cross-tab analysis between these two indicators shows some important relationship between how frequently the rice producers use the mobile phone and how relevant they find the information receive through the use of mobile phone. Among 600 participants a majority of two hundred and seventy of the rice producers considered the information received as relevant, and one hundred and fifty-one of those users use the mobile phone every second day to communicate with commercial contacts. Among six hundred participants one hundred and twenty-two expressed the information through mobile phone very relevant for their commercial use. Among these participants, one hundred and eighteen use the mobile phone every one to two days to communicate with their commercial contacts. Therefore, there is a distinct relation between how often the rice producer uses mobile phone and how relevant their find information for their commercial purposes. The chi-square significance value of .04 indicates that there are high probabilities that these two sets of variables are directly proportional with a 96% chance that there is a link between them. This means that the participants who rate the commercial information as relevant also tend to increase their frequency of communication with the commercial contacts.

Freq. (days)	Information Relevance to commercial engagement					Total
	Not at all	Less relevant	Average	Relevant	Very Relevant	
1	1	3	5	86	79	174
2	0	2	5	151	39	197
3	0	3	72	28	1	104
4	0	3	27	4	1	35
5	2	17	21	1	1	42
6	3	8	4	0	1	16
7	5	18	0	2	0	25
8	3	2	0	0	0	5
9	1	0	0	0	0	1
10	1	0	0	0	0	1
Total	16	56	134	272	122	600

	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.04
Likelihood Ratio	0.00
Linear-by-Linear Association	0.00
N of Valid Cases	600

Table 6.1 –Cross-tabulation of Frequency of communication with commercial contacts, and relevance to commercial engagement, and Chi-square test

The box-plot below explores the relationship between these two indicators. The box plot shows a congruent relationship between these two indicators, where it shows the rice producers who use a mobile phone more frequently (0-2 days) find the information very useful for commercial engagement. On the other end, the rice farmers who use the mobile phone less frequently (4-6 days) find the information slightly useful for commercial purposes. Although the less frequent user of mobile phone finds the

information useful, but the degree of their usefulness is lower than the frequent mobile phone user. The boxplot chart shows a trend between these two variables, but how they impact each other is difficult to determine. The participants who expressed their usefulness as 'very high' also used the mobile phone more frequently.

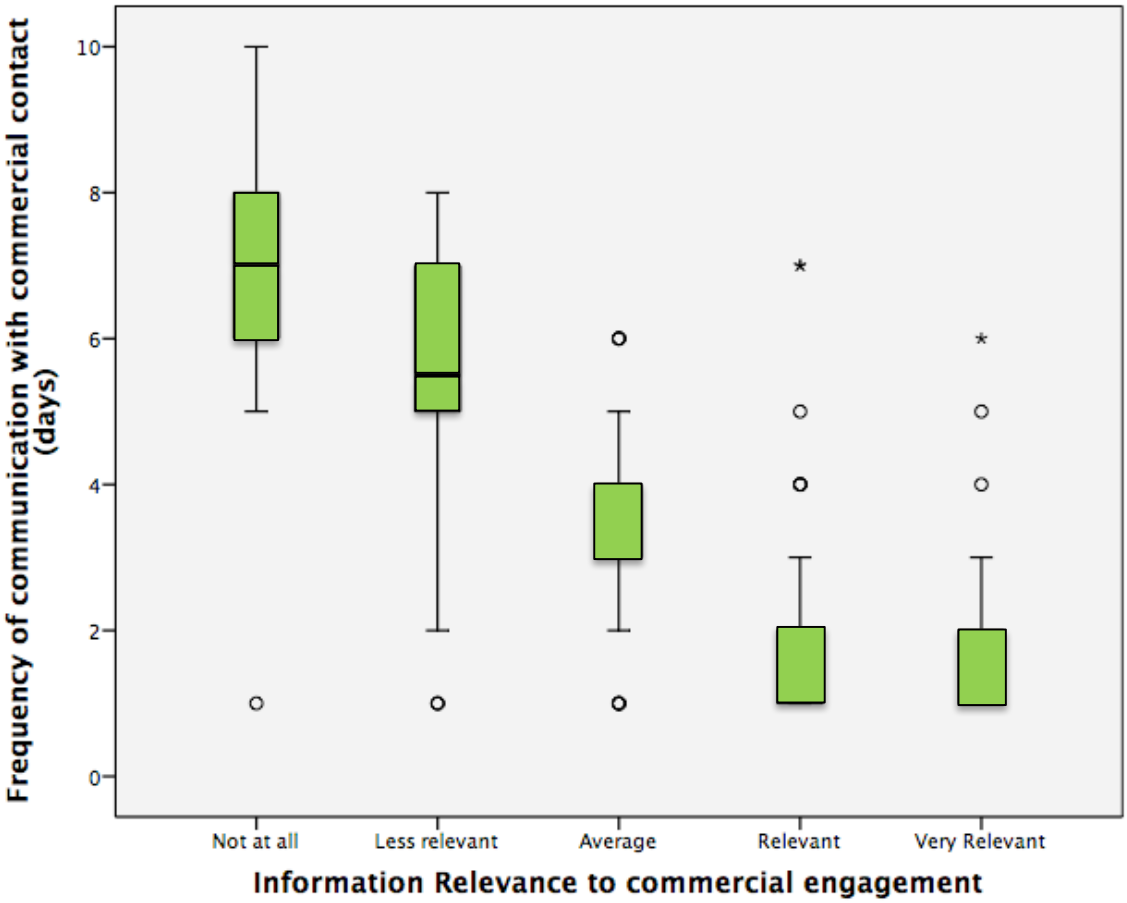


Figure 6.1 – Box-plot depicting communication frequency with commercial contacts against perceived relevance

Therefore, whether the frequent use of mobile phones triggered the information relevance for the rice producers finding them more useful, or whether the recognition of usefulness increased their mobile phone usage was difficult to determine. This recognition of different degrees of relevance (from slight usefulness to high usefulness) is the rice producers' own judgment or opinion. These attributes are part of rice

producers' agency impact. On the other hand, how often the rice producer wants to communicate with their social or commercial contacts is the rice producers' decision, therefore, his/her choice.

6.3.3 Impact of choice and timeliness of information

The previous section shows the perception of usefulness, relevance on how often the rice producers use the mobile for their commercial or social necessities. The frequency of the use of mobile phones also varies from one rice producer to another. Similarly, the number of contacts the rice producers have also varies for these rice producers. Section 5.1 shows that the number of commercial contacts varies with the farmers' financial well-being and correlates with their number of commercial contacts. The section also shows that the majority of the participants' networks consist of largely social contacts. However, the comparison between pre-harvesting and harvesting season showed that their information need dictated the nature of their mobile phone usage. The key findings of section 5.2 showed that the social network also benefitted the participants by providing commercial information. Therefore, the number of contacts the participants have is dependent on the individuals' choice, and indicates sources of information. The choice implications of the participant (section 6.1) reflect the way in which the participants use their mobile phones to receive the desired outcomes. Among the participants, 41% believe the information received through mobile phones to be almost always very timely. However, similar to the relevance discussed in the previous section, the timeliness is also another attribute of the mobile phones that enable the participant to receive information in times of need. As the choice outcome and seasonality impact showed earlier, it is the information access during times of need that motivates their use of mobile phones. Therefore, it is important to observe the relation between the number of contacts and timeliness of information.

The number of contacts the rice producers have in their mobile phone is dependent on the rice producer's choice of how many contacts he/she wants to have on their mobile phone. In the survey research, the rice producers were asked how many contacts the rice producers have on their phone and the extent to which 'timeliness' is important to the rice producers (from a scale of never to always).

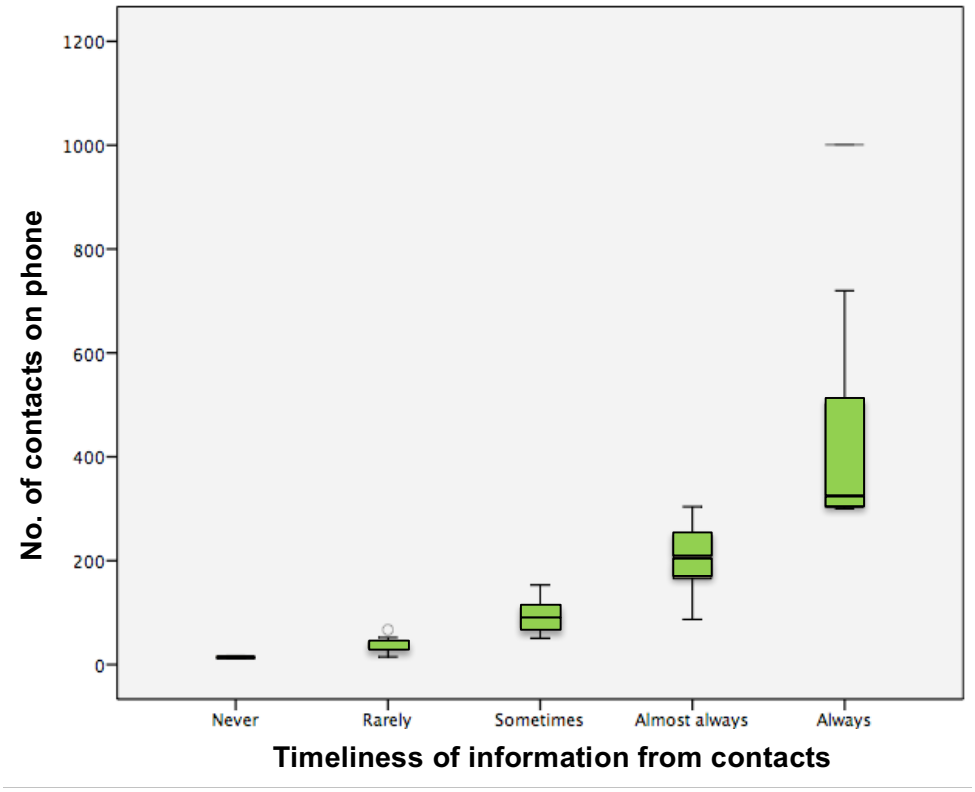


Figure 6.2 – Box-plot depicting the number of contacts against the timeliness of information

The boxplot shows the relationship pattern between the number of contacts and the timeliness of information received by the rice producer. According to the graph, there is an observable positive trend between the number of contacts on the phones and the timeliness of receiving information through a mobile phone. The number of connections also indicates an increased number of options for the rice producers to communicate with a wider number of people. Other agency pointers such as the age,

education or the social skills also contribute to the number of contacts the rice producers built over the period he or she has been using the mobile phone. Sen's (1999) example of choice in this particular example has the limitation by the agency influence, such as the age of the participant. The perceived benefit of using mobile telephony can also raise questions since the mobile-based network and the physical network of the farmers are not two completely different sets of contacts. Although family and friends are the most 'trusted' group of the people for the farmers and the physical proximity plays a vital role in their trust on the contacts, a question may arise how these people with regular communication can provide information or knowledge that can benefit the farmers, provided these contacts are from similar surroundings. Similar concerns have been mentioned by Ospina & Heeks (2012) about the knowledge creation that is limited within the community the farmers live in. However, looking at this accessibility and choice from a 'social choice perspective' Peter (2003) shows that although we are considering farmers as a homogenous group of people in terms of their use of choice, there is heterogeneity within the group with different levels of importance of voices (dictated by cultural practices) being heard within the community. Although the research by Peter (2003) is mainly from a gender perspective, such different levels of acceptance can exist from other socio-economic perspectives as well, such as economic, education or social class disparity. From a farmer's perspective, it is even more complex with regards to how the individual identifies himself as an agent to interact with the society since there are different social groups within the community and the individual's significance of owning a mobile phone and their attitudes and behaviours can be different from each other. Another research on the farmers and their technology usage in India, from the Himalayan region showed the lack of information that was observed by the research does not essentially lead to information seeking behaviour, primarily because it dependents on the return and value from the information (Kameswari, et al., 2011).

The information-seeking behaviour of the participants of the research was observed in the case studies (section 6.1) where it was seen that the participants use the mobile phones to receive information for their commercial and social purposes. Apart from being driven by their needs, the structural dimension (section 5.3) relates their information seeking behaviour with the trade practices or norms of these participants in receiving information from various sources. Therefore, it is not entirely about their own influences (agency influences such as age and education), but also the structural aspect such as the existence of information supply chain influence information seeking behaviour among the participants. Therefore, the social structure, agency influence and choice are intricately related.

6.3.5 Observation on agential dimension of the provisioning

The agency dimension of the rice producers that is linked with choice is directly influenced by the age, education, trust, and geo-location of the rice farmers. Rice producers age shows the rice farmers who are younger prefer to use the mobile phone more frequently to communicate with the commercial contacts compared to the elderly rice farmers. Therefore, the young farmers who are in rice business have more potential to take advantage of this medium for commercial purposes. The education data set shows, despite 43% of the rice producers not receiving any formal education; their mobile phone usage is not different from the educated rice producers. The formal education of the rice producers is not a barrier towards taking advantage of this technology as the rice farmers learned how to use the mobile phone for their commercial contact through peer influence as mentioned in the case studies. The gender aspect does impact the mobile phone use for the commercial purposes, as it is fundamentally reliant the capacity to which a female rice producer is involved in the agricultural process. From the case study example, if the female members work actively in the process of cultivation than her use of mobile phone is not different from

male rice producers - as she also uses mobile phone to communicate with relevant input suppliers, buyers and takes the decision in the overall rice farming process.

The rice producers' trust has a direct impact on their number of contacts. The more trust the producers have the information they receive through the mobile phones, and the number of contacts increases for the rice producers. However, the spatial analysis of the contacts shows 48% of the total commercial contacts the rice producers exist within 1-3 miles. Because of the nature of their business, the rice producers prefer to use the nearby input suppliers and buyers for their convenience.

The survey research showed that 18% of the total sample prefer to communicate face-to-face with the commercial contacts such as seed suppliers, buyers, and government extension agents, etc. The majority of the respondents prefer to use both mobile phone and face-to-face to communicate with their commercial contacts. Therefore, the actual preference of social or commercial connectivity is reflected through their mobile phone usage; and the pattern and the content is reflected by their mobile phone usage and how they keep relations in their daily life (Hahn & Kibora, 2008). Research by Hahn & Kibora, (2008) in the rural areas of Burkina Faso showed oral communication to have an important role in rural life. The case studies of this research show a similar preference by the rural rice producers who communicate with their social and commercial contact orally because of their traditions. Furthermore, the people in rural areas have a need to communicate socially with their relative and friends, and for the rural rice producers the mobile phone did not change their communication or social practices but mobile phone usage was adapted according to the existing communication and local norms.

Therefore, the communication through the mobile and face-to-face are intertwined and inseparable. This constant use of mobile phone also has an effect on their

communication behaviour. The survey data on the unique features of the mobile phone; timeliness, importance, and relevance, has shown the participant's view on the mobile telephony as media of communication. Among the respondents, 28% believe the information received through mobile phone as very important, and 27.7% believe the information received through mobile phone is important. In the case study section, Mr. Dipon (case study one) mentioned the 'mobility' factor that allows the participant to be able to communicate with his social and commercial contact. Case study three (Mr. Shopon) stresses that their importance of the mobile phone is related to the information accessibility from the government extension agent. The importance of the mobile phone has a direct association with the 'anytime' feature of mobile telephony. The 'mobility' referred by the participant and the participant links the information accessibility that came as an important aspect of owning the mobile phone with receiving information in time. According to the survey data, a total of 300 participants (50%) believe the information almost always and always timely through a mobile phone.

Thirty-eight percent of the respondents find information received through mobile phones to be 'sometimes useful'. Eleven percent of the total respondents find the mobile phone to be never useful. In the case study eight, Mr. Siraj finds his mobile phone to not be a vital element for his social or commercial interaction. The participant's mobile phone usage is predominantly used for social interactions and participant also utilizes a mobile phone to communicate with the commercial contacts. Although, the participant does not consider the use of mobile phone as vital input for his trade, based on the mobile data usage comparison between harvesting and non-harvesting season shows 14% more communication with commercial contacts through a mobile phone. That indicates the use of the media for commercial purposes increases, as need rises for the participant. Among the participants, a total of 63.5% finds mobile phone relevant for their trade. In the case study, two (Mr. Babu) related his

importance to socio-economic partitions, where he believes the mobile phone gives him access to communicate with people from different socio-economic tiers. The participant also does his trade with these selected commercial contacts. Based on the SNA map of the participant, the mobile communication of the participant is mostly dictated by the communication with these contacts. The case study four (Mrs. Mita) consider mobile phone as an important for her rice production because it allows her to communicate with relevant people in the business. The participant also uses mobile-based helpline service provided by MPower-USAID call centre. The MPower-USAID case study data also shows different rice production related problems that have been addressed through the mobile-based application for the farmers.

In case study one, the participant has commercial contacts within a commutable distance and contacts that are located in distant villages. According to this participant, he prefers to communicate with the local commercial contacts with mobile phone and face-to-face. Based on the network map of the participant, the local government seed supplier (BADC) is the nearest commercial contact of the participant. According to the participant for any supply-related information and arrangement; the mobile phone is convenient over face-to-face communication. According to the SNA Map (Case study one), the participant linked with a transporter through a non-dyadic commercial contact.

6.4 Structural aspect of provisioning

According to Giddens, structure can be explained by the "rules and resources recursively implicated in social reproduction; institutionalised features of social systems have structural properties in the sense that relationships are stabilised across time and space" (Giddens, 1984 pp 24). Here, the commercial contacts, which is the formal/informal commercial network represents structure for the farmer. As Giddens denoted, it has certain rules and resources that are recursively implicated in social

reproduction. The agential dimension in the previous section discussed the individual rice producer's choice and their preferences of using mobile. The structural dimension explains the particular distinction about their commercial and social contacts and the nature of those contacts. Along with their types of connections, the structural dimension also presents the knowledge these rice producers built. The knowledge that reflects how these rice producers utilize their mobile phone for their commercial benefit is also influenced by how these rice producers emphasize the importance of commercial contents through the use of mobile phone. The overall discussion in this section begins with the case study data on the nature of the network the rice producers create, followed by the impact of these social/commercial contacts. To explain the importance of commercial contents, the data gathered from the survey research has been utilized.

6.4.1 Social network analysis of case studies

Case studies on network data discuss in detail about the different types of the network created by these participants. These types ‘dyadic' and 'non-dyadic’ networks have been discussed in the literature review. The dyadic contacts for these participants are determined based on how frequently the rice producers communicate with the contacts (appendix V). The types have been determined by the details of the nature of their network provided by the farmers. The SNA mobility map provides the visual pattern of the relationship with both social commercial contacts. Some of the key observations of the social network analysis are –

1. According to the participants, the mobile phone had enabled them to be able to communicate more frequently to the same contacts than before, which led to more reciprocity. This particular medium in cases means more intimacy, intensity, and association - therefore creating strong-ties for the participant. From a network analysis perspective, the type of network (weak or strong)

centrality refers to how far or close the participant is from the other nodes in the network (Freeman, 1978).

2. Another aspect of the network that is discussed in the following section is the multiplexity of networks. Among the social and commercial contacts, the participants communicate with some of the contacts with both face-to-face and mobile telephony. These are friends and commercial contacts that are socially closer to the participants. The information received from these individuals is regarded as highly trustworthy. These are contacts the participants' mentioned as their most frequently communicated individuals.

3. These close contacts by the participants' definition, are those contacts with whom the participant interacts frequently compared to other contacts. When questioned about their communication with distant contacts, whom the participant does not contact that frequently, participants believe the advantage of having a mobile phone that allows them to communicate with these spatially distant contacts. From a social network perspective, the participants use mobile telephony to communicate with both strong-ties and weak-ties. The mobile telephony enhances the ability of the participants to maintain both types of ties. This is contradictory to the research by Goodman (2005) on the Tanzanian small medium enterprises. His finding shows a majority of the participants use mobile phone to communicate with 'weak ties'. In the case studies, the practices of the participants show the opposite of what was discovered by Goodman (2005), where the participants use mobile phone predominantly to maintain their communication with 'strong ties.'

4. From a commercial point of view, there are non-dyadic commercial contacts such as distant buyers, suppliers with whom the participants do not have frequent communication, but they contact when needed. There are also

commercial contacts who are non-dyadic with whom the participants communicate more frequently such as the call-centre. There are also dyadic commercial contacts, such as the local arothdar who are the regular buyers for the participants; also, the close-tie commercial contact for the participant.

5. In some cases, the participants do not develop new commercial contacts. Instead, they created some trusted commercial contacts and preferred to do most of their agro-based trading with these contacts.

6. There are social contacts, with whom the participants regularly communicate for social purposes. On the commercial aspects, there are contacts who are strictly related to the participants' rice production business such as buyers and suppliers. Some participants do not have connections with market informants, or with extension agents and call-centres.

7. The participants have a range of social and commercial contacts. There is heterogeneity in the number of commercial contacts the participants created. There are farmers in the participants' contact lists who are involved in the other types of farming. These contacts are also being communicated with in times of trade necessity. The participants communicate with these contacts for selling produce and using transport. These are the structural-hole that provides commercial benefit to the participant.

8. There are non-dyadic social contacts, with whom the participants do not communicate frequently. There are also social contacts with whom the participants became connected through dyadic contacts. Among the commercial contacts, there are dyadic contacts with whom the participant frequently interacts for trade-related communication.

9. According to the participants, there are some social contacts with whom the participant discusses social and commercial aspects, such as the local friend, brother-in-law and some cousins who are in involved in the same trade. There are social contacts that are not in a similar profession and very close to the participants mainly from a social connectivity perspective. There are participants who keep distinct relationships with the social and commercial contacts. Based on their pattern of exchange, it is evident that the participants do not discuss business with social contacts and vice-versa. Therefore, there is no multiplexity of relationship in the network, but dyadic relationships with both social and commercial contact.

6.4.2 Importance of commercial content and its impact

Rice producers stated commercial content as the communication with social or commercial contacts that has commercial significance. The commercial contents include information related to input/output price, information on crop, seed, pest, etc. This information received through mobile phone also influences how the rice producer considers the usefulness of mobile phone. In the following section, the survey dataset shows a comparison between how the rice producers considered the importance of commercial content (scale from very important to not so important) with the increasing number of their commercial contacts. The rising number was measured by asking the new added commercial contact in the last one year. The increasing number of contacts indicates more use of mobile phones by the participants and their dependency on the phones for communication purposes. How important the rice producers find the commercial contents indicates their knowledge about the use of commercial contents using mobile phones. Therefore, the increase of commercial contacts has a potential trend with their use of mobile phones for more commercial engagement.

		Increase		Total
		Yes	No	
Importance of commercial content	Very Important	177	11	188
	Important	266	12	278
	No so Important	51	13	64
	Not important	19	51	70
Total		513	87	600

	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.04
Likelihood Ratio	0.03
Linear-by-Linear Association	0.00
N of Valid Cases	600

Table 6.2 – Cross-tabulation of perceived importance and increase in the number of commercial contacts

One-hundred and eighty-eight of the rice producers considered the commercial content as 'very important', and among these respondents one hundred and seventy-seven added new commercial contacts since the last year. A majority of the rice producers considered the commercial content as 'important', and among them, two hundred and sixty-six respondents mentioned they had added new commercial contacts since the last year. On the other end, a total of seventy participants described the commercial contacts as 'not important', and fifty-one of these respondents did not add any new contacts. However, there were also nineteen such rice producers who added commercial contacts but considers the commercial content 'not important. This indicates that the relationship between how important the participants consider the commercial content shared through the use of mobile phone to be, and the growth of their commercial contacts to have a positive link. Furthermore, the Chi-Square value of 0.04 indicates a strong likelihood of a positive relationship between these aspects. This means, that

the participants who use the mobile phones to communicate with their commercial contacts stress the importance of commercial content exchanged through mobile phones higher than those who communicated face to face. The cases show that the communication between the participants and their commercial contacts are not the only source for commercial contents. The participants also engage with their social contacts for commercial purposes. The participants' commercial interactions impact their use of the mobile phones and their commercial engagement.

6.4.3 Importance of commercial content and different types of media

The rice producers are reliant on the local business ecosystem for their commercial efforts. The proximity of the local input suppliers and produce buyers plays a critical role in their business success. Therefore, face-to-face communication is crucial and natural among rice producers, despite the ownership of the mobile phone. Therefore, to understand the importance of commercial content accessed through the mobile phone is necessary to learn. This information distinct the parallel importance of mobile phone as media despite their option to communication with the commercial contacts face-to-face. In the survey of the rice producers they provided information on their level of importance of commercial content through the use of mobile phone and the data is compared with the different media of communication.

Importance of commercial content	Types of communication				Total
	Mobile phone	Land line	Face to face	Mobile phone and face to face	
Very Important	13	1	24	150	188
Important	5	0	41	232	278
No so Important	0	0	16	48	64
Not important	0	2	62	6	70
Total	18	3	143	436	600

	Asymp. Significance. (2-sided)
Pearson Chi-Square	0.04
Likelihood Ratio	0.04
Linear-by-Linear Association	0.03
N of Valid Cases	600

Table 6.3 – Cross-tabulation perceived importance of commercial content and types of media used for commercial purposes

Among the participants one hundred and eighty and eighty-eight participants mentioned commercial contents to be 'very important', and among these participants one hundred and fifty used a mobile phone and communicated face-to-face. Among the two hundred and seventy-eight participants who expressed the importance of commercial content as 'important', a total of two hundred and thirty-two rice producers use the mobile phone and communicate face-to-face with their commercial contacts. On the other end, there were seventy participants who described commercial content to be 'not important' of which sixty-two communicated with their commercial contacts only through face-to-face communication. This indicates that the rice producers who use mobile phones for their commercial purposes exchange valuable commercial contents with their commercial contacts, and the rice producers who own mobile phones but communicate with their commercial contacts only face-to-face do not gain any commercial advantage through using the mobile phone. This trend

between these two variables also reinforces the previous findings that shows the participants who find the commercial content important tend to increase their number of commercial contacts. Similarly, the importance of commercial contents is high among participants who use mobile phones to communicate with their commercial contacts. The Chi-Square value of 0.04 indicates a strong likelihood of an association between the variables and these congruent findings indicate that the commercial use of mobile phones increases the commercial value for the rice producers from a resource based view perspective.

6.4.4 Mobile phones to complete business transaction

The rice farmers who use the mobile phones to communicate with their commercial contacts also communicate by face-to-face communication. The rice producers, as seen in the earlier section, exchange commercial content and consider these exchanges to be important. In the survey, data on the number of rice producers using mobile phones to conduct business transactions has been collected. Another dataset on the percentage of the frequency of mobile phone use in comparison to face-to-face communication with their commercial contacts has been collected. This percentage ratio shows a comparison between mobile phone and face-to-face communication among them. This also indicates a high volume of communication taking place between the rice producers and their commercial contacts through the use of mobile phones in parallel to face to face communication. The data shows a total of four hundred and twenty people responded to complete the business transaction through the mobile phone. Among these participants, two hundred and sixty-one participants use mobile phone eighty percent of the time to communicate with their commercial contacts.

Mobile phone to complete business transaction	Frequency (Mobile and face to face ratio)					Total
	80:20	60:40	40:60	20:80	10:90	
Yes	261	154	3	0	2	420
No	3	1	12	51	113	180
Total	264	155	15	51	115	600

	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.03
Likelihood Ratio	0.03
Linear-by-Linear Association	0.00
N of Valid Cases	600

Table 6.4 – Cross-tabulation on the usage of mobile phones to complete business transactions against the ratio of communication type

Another one hundred and fifty-four participants use sixty percent times to communicate with their commercial contacts. One-hundred and five participants who responded affirmatively on completion of the business transaction with mobile phones mentioned their usage to be 20% or less to communicate with the commercial contacts. Therefore, these individuals use the mobile phones in very limited occasions, when completing transactions. Most of their commercial contact is carried out face to face, and instances of communication with transporters and support workers largely required the mobile phones. On the other hand, from the rice producers who said that they do not use the mobile phone to complete transactions, a total of one hundred and thirteen participants, in only ten percent of the occasions communicated with the commercial contacts. The outliers in this group are three participants who use mobiles to communicate with the commercial contacts eighty percent of the time, but do not complete business transactions through the mobile phones. The respondents explain that their business transactions are completed face-to-face with the local buyers and

input suppliers, and the mobile is used mostly to communicate with family members who are in the same professions. Overall the data indicates that those who use mobile phones in most of their communications, are also those who use them the most for commercial transactional purposes, and a strong association between these is observed through a Chi-Squared value of 0.03.

6.4.5 Commercial content exchange and financial benefit – case studies

In this section some of the case studies are synthesized and their commercial content exchange is discussed. The individual cases vary according to their commercial contacts and the cost saving perspective. The cases show, in times of emergency, the mobile phone was an invaluable tool for communication. Similarly, the commercial benefit according to the participants is intangible, where the participants communicate with the contacts that are dependent on the market and opportunity. Some examples from the case study shows the cost associated with the call on an average 6-10 Taka (6 pence). Their communication with the transporter and the buyer together less than 12 Taka (8 pence). There is a case participant who mentioned the last income from the Boro season a gross profit of 70,000 Taka (GBP 400) was earned from which the cost was 52,000 Taka (GBP 315). There was no added marketing cost other than the phone calls which cost him 10-15 Taka (GBP .10-.15). During the harvesting time, the participant communicates with the other buyers to confirm the price, which also benefit the farmers by saving 10 takas per KG production. The case participants have no landline connection in the house, and because of the children in the house, the female participants cannot physically commute to the relevant commercial contacts, where mobile phone is the only option to communicate. Therefore, from a financial point of view, the participants believes they are certainly financially beneficial to be able to communicate and get assistance from social/commercial contacts.

According to the participants, the information received by the commercial contacts particularly in time of crisis is the biggest financial advantage. Based on the

participant's example during an Aman season in 2012 the participant's rice production was affected by a disease outbreak. The information from the extension agent regarding the pesticide saved him approximately 30,000- 40,000 taka (GBP 300-350). This information and arrangement with the pesticide supplier were conducted using a mobile phone. The case study participants believe that the mobile phone works not only for marketing but also as an assurance of timing and confirmation of the trade. According to the participants, the mobile phone has an indirect effect on trade rather than any direct cost. Therefore, the commercial or financial benefit is difficult to measure. According to one of the participants, in 2015 his land was filled with access water due to heavy rain in the Aman season. The participant needed advice and support from the family members to create the drainage for the field. All the communication was done primarily with using a mobile phone because of the rain there were no means to communicate with the extension agent and the family members. On that occasion, the mobile phone was instrumental in providing the solution on time - therefore constituting an indirect financial benefit from the use of mobile phone. From a trade perspective, on occasions the participants do not sell the produce to the same buyer every time. According to the participants, the mobile phone is the only device which allows them to communicate with the distant market to negotiate price. Therefore, there is a distinct financial gain from using the mobile phone.

6.4.6 Observation on structural dimension of provisioning

The structural dimension is linked with the social/commercial network, knowledge creation and the commercial transaction of the rice producers. The network created by the rice producers shows a total of 87% of the total contact are family, friends and other social acquaintances. In the mobility map of the rice producers, it is observed that the commercial contacts of the majority rice producers are within the reach of three to seven kilometres. Therefore, the both social and commercial contacts of the

rice producers are spatially within a certain distance. This preference of mobile phone use limits the possibility of the rice producers to be able to establish distant commercial contacts. Despite the proximity, the use of the mobile phones by the rice producers as shown in the data set (section 5.3.1), 33% use the mobile phone every alternative day to communicate with the commercial or social contacts. However, from the seasonality analysis, the case study research showed the communication during harvesting season to have high volumes of daily phone calls to their commercial contacts. This communication patterns changes in lean period, where the rice producers use the mobile phone mostly to communicate with their social contacts during that cycle more than once a week. Therefore, it shows mobile phone to have an instrumental effect in commercial communication among the rice producers. All the individual cases show a high communication volume with their commercial contacts during harvesting season that changes during lean season. This communication pattern is also related to the knowledge creation dataset (5.3.8). The 37% of the rice producers mentioned price, quantity, and marker as the main knowledge acquired through the mobile phone. So, the rice producer's high volume communication during the harvesting season is mainly about that information.

The social network analysis map in the case studies shows the network of commercial and social contacts are not similar from one farmer to another. Some of the commercial contacts with whom the rice producers communicate are dyadic; that indicate the strong relationship between the rice producer and the commercial contact. This strength of their relationship also reflected in their frequency of communication. So, the more frequent communication that has also been observed represents the strong relationships of these rice producers. As the rice producers find the mobile phone as useful their number of contacts over year increases. This importance also reflected in the commercial communication preference using mobile phone among the rice producers. As the data shows among one hundred and eighty-eight respondent

considered mobile phone as very important prefers face-to-face and mobile phone communication combined. However, very specifically the rice producers who complete their transaction using mobile phone communicate 80% times using mobile phone with their commercial contacts compare to face-to-face communication. This is a very significant number that shows despite their use of mobile phone and face-to-face to communicate with the commercial contacts the transaction is done by those rice producers who communicate profoundly through the use of mobile phone.

6.4.7 Observation on socio-technical provisioning

The agential dimension (section 5.1) shows the agency influence on the use of mobile phones. The age, education, gender and land size signified the distinct use of the participants. The other aspect that impacts the use of mobiles for commercial use by the participants is reliant on the social/commercial network creation and existing commercial practices that allows the network to be established with these contacts. The frequency in which the participants communicate with these contacts and the content of their discussions are part of the structural dimension of the participants. The interconnections between these dimensions is reliant on the rice producers' choice, trust and commercial/social practices. Therefore, the number of contacts the participants have and the frequency of communication is not only influenced by their agency attributes but also the institutional practice that allows the participant to exchange communication with the social/commercial network. The network structure and the participants' agency influence are the foundations for the socio-technical provisioning. This network structure of the participants (section 6.4) shows how the structural dimension that determines the way in which participants will be benefitted through the network. Therefore, how the provision forms through the interactions between the agential and structural dimension are important to discuss.

6.5 Formation of provisioning

Broadly, the framework divided the influence of mobile phone commercial usage of the rice producers into two categories. These two categories were made possible through the structuration theory that clearly defines between agency and structure. The framework further attached the choice aspect to create the agential dimension. This capability of the rice producer is to be able to use mobile phone according to their need has been established in the data analysis and interpretation section. Each and individual elements of agency impact discussed - age, education and gender influence how the rice producer perceive and use the mobile phone. Therefore, their capability of using a mobile phone for commercial purposes is directly impacted by the agency inputs along with their choice dimension. The choice dimension has further shown in the previous section (Section 5.2.3) in comparison with different indicators such as timeliness and relevance of information received through the use of mobile phones. The other aspect of the framework is the structural dimension. The structural dimension of the rice producer represent the structure of the structuration theory that dictates the norms and the social/commercial settings within which the rice producer operates. The influence of this dimension is also shown by the rice producer's social-commercial contacts and their institutional practices. The commercial contacts that the rice producers communicate with such as input suppliers, government extension agents, and peer rice producers are not different from farmer to farmer. However, how often they interact with the commercial contacts and how strong their commercial connectivity with these contacts depends on their agential dimension and how they exercise their ability.

Socio-technical provisioning is the phase where these two aspects; agential and structural dimensions intersect. In the figure below this intersection has been described. Within structural dimension, the institutional practices show how the rice

producers' commercial practices along with the knowledge creations and different types of businesses conducted by these rice producers. The institutional practices are also about how these rice producers do businesses. From the data shown in their nature of their social and commercial contacts (5.3.3), we have seen how they communicate with not only their commercial contacts but also social contacts to conduct business. The social and commercial contact maps (section 5.3.3) show that there is a local communication practice that the rice producers adopt also influence how many social or commercial contacts that the rice producers will create. Similarly, the choice dimension of the rice producers that is within the agential dimension of the rice producer influence how the rice producers perceive the communication with using the mobile phone as something that is important, timely, and relevant for their commercial interest. However, within this sociotechnical provisioning, the elements such as choice also influence the social or commercial contacts, because how many contacts the individual rice producers will create is a matter of choice (section 5.1). These distances between these two aspects - choice and institutional practice the rice producers have the provisioning span that is unique and differs from rice producer to producer. These unique provisioning, therefore, is formed by their combinations of agential and structural dimensions. The way in which these rice producers create commercial knowledge or how these rice producers complete their business transactions through the use of mobile phone are the examples of how the institutional practices and the socio-technical capacity meet and create the provisioning for the rice producers.

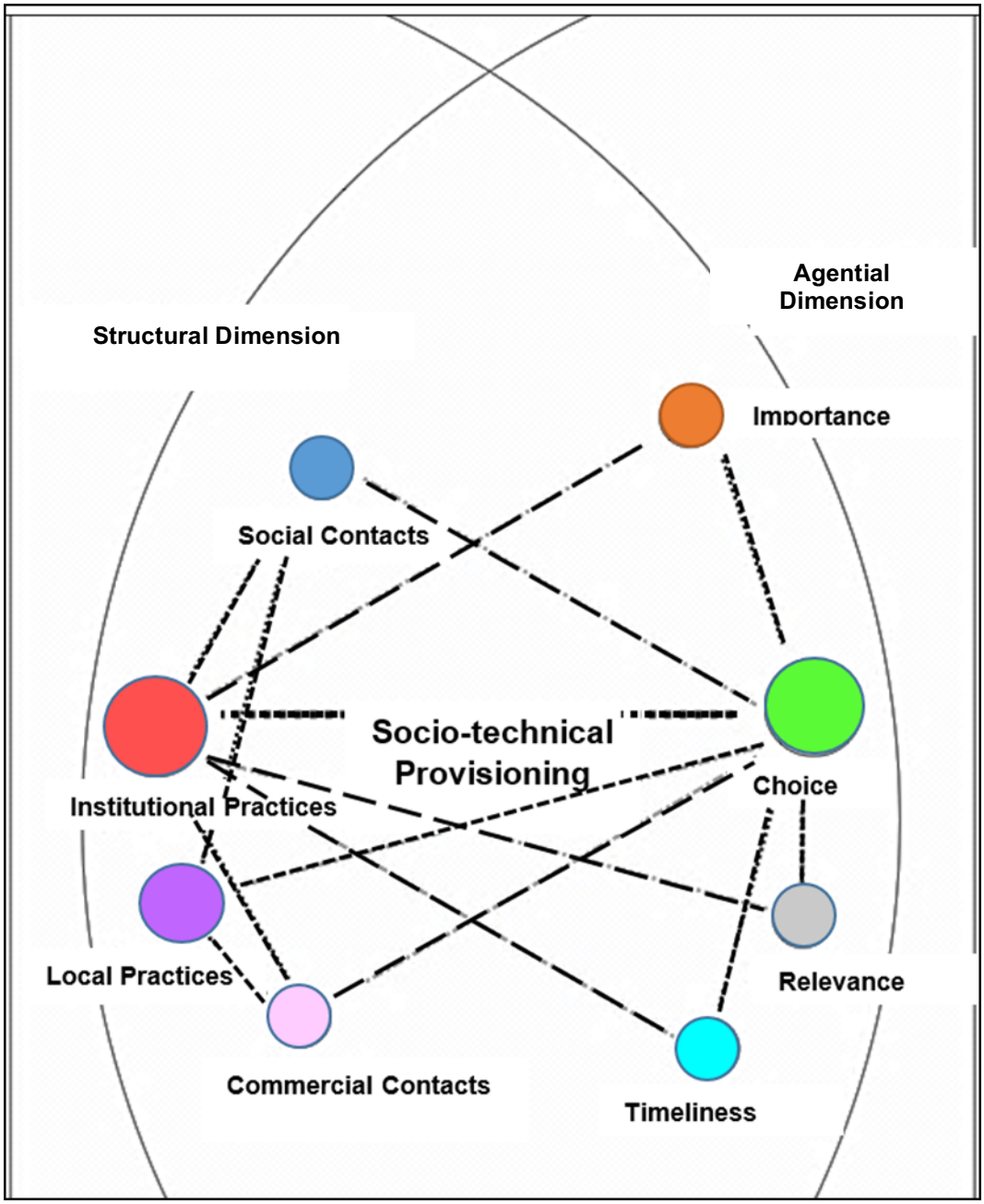


Figure 6.3 – Formation of provisioning

6.5.1 Communication, provision and resources

The Sociotechnical provisioning differs between rice producers in terms of the numbers of social and commercial contacts it creates, and is linked to the difference in their choice. The choice as we have seen earlier dictates their level of interactions with the

different social and commercial contacts. The institutional practices remain the same across the country as the rice producers use both formal/information network for their commercial supply-chain (Sec 2.3.4). The creation of resources is dependent on the number of contacts the rice producers create and how the rice producers choose to use the mobile phone to conduct commercial activities. In section 6.4.4 the data showed that only thirteen participants used mainly mobile phones to communicate with their commercial contacts and considered the commercial content to be very important. The rest of the one hundred and fifty rice producers who considered using both mobile and face-to-face communication also considered commercial content exchanged through the use of mobile phone to be very important. These rice producers out of six hundred are capable of creating financial resources through the use mobile phones. The difference between the perceived importance and use lies in the choice of the rice producers. Those who chose the mobile phone as the primary communication medium, completed their commercial negotiations and price determinations through the mobile phones. Also, from the case studies, an example on the opportunity cost shows the rice producers to benefit on their transportation costs when they use the mobile phones. Therefore, there exists the possibility of creating financial resources by saving money and also using the device to finalize the commercial negotiations with the buyers and input sellers. The rice producers who prefer to employ both mobile phones and face-to-face communication consider the mobile phone as a medium that allows them to be able to communicate with the commercial contacts, and therefore, a tool that enhances his or her commercial efforts. This enhancement for commercial interest creates a commercial capital for the rice producers. In the conceptual diagram below, the creation of commercial capital has been highlighted.

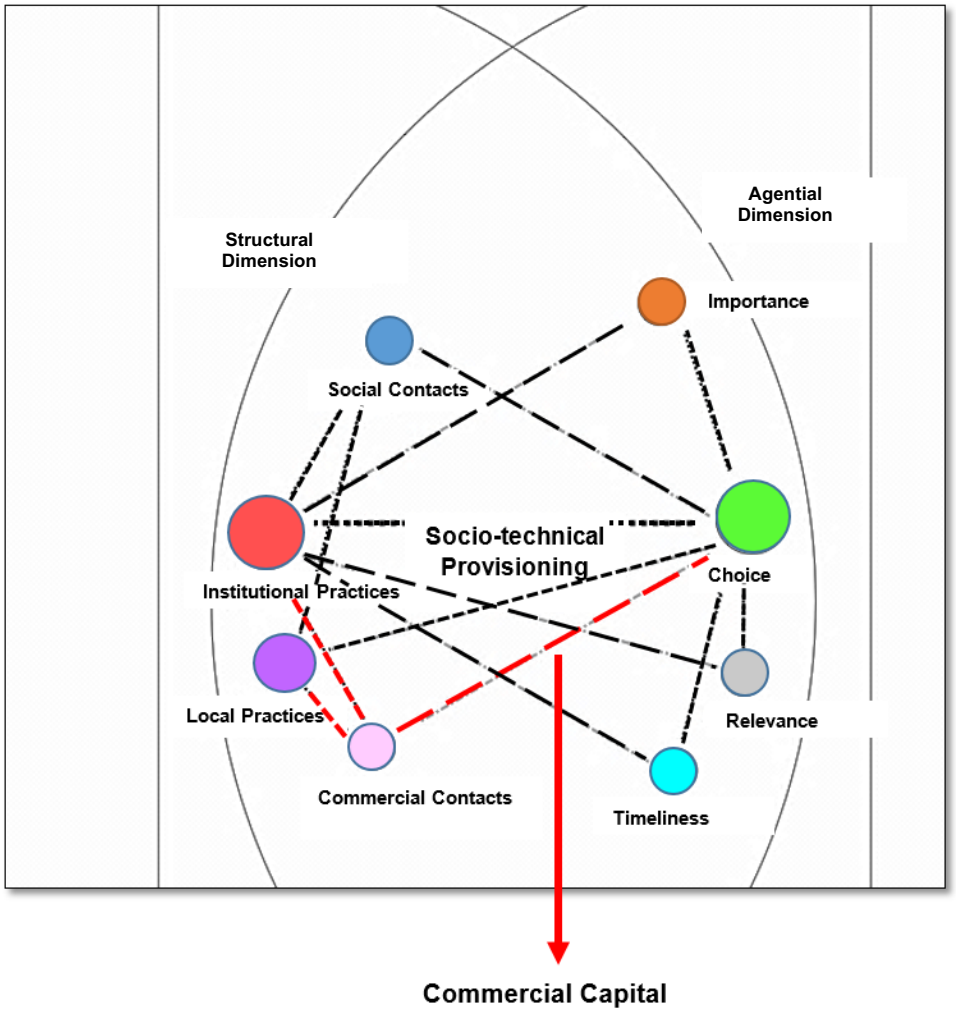


Figure 6.4 – Formation of provisioning – creation of capital and resources

These rice producers created commercial capital, unlike the rice producers who created financial capital (section 6.4.5). Therefore, the different forms of capital/research-creation are dependent on the different level of choice and institutional practices for the rice producers.

6.5.2 Conceptual framework revisited

The theoretical framework presented earlier (chapter 3) shows that based on the philosophical perspective of the research there is duality in the process of mobile phone usage by the rice producers of Bangladesh. There is a structure that was discussed in the structural dimension of the rice farmers and the agency influences that was

discussed in the agential dimension. According to the framework, these two dimensions intersect and creates the socio-technical provision (section 3.2.7). The agential dimension reflects the way in which the nature of mobile phone usage (a technical capacity of the rice producers), is influenced by their social circumstances and the agential factors. These factors individually influence the way in which the rice producers use their mobile phones.

The theoretical discussion about choice further shows the interrelated nature with the other agential influences such as gender, where the choice of the female rice producers is different from the male farmers (Section 5.2.4). Similarly, factors such as trust and land ownership shape how the rice producers communicate with the social and commercial contacts. On the structural dimension, networks differ in their nature. The network of the rice farmers can be strong-tie or weak-tie relations. There is also another distinction such as multiplexity within the network. The knowledge creation and contents shared between the network is based on the practices that dictate network created by the rice producers.

The earlier discussion on the (section 2.4.9) resource-based view explains how the rice producers view of the mobile phone as a resource can be identified by their use of mobile phone for commercial purposes. The livelihood approach highlights the motivations that potentially drives rice producers to use their network to cope with vulnerability (section 2.4.1). The framework that shows the different motivations and influences is a process through which the rice producers convert the information exchange through the use mobile phones to capital or resource.

The data presented (chapter 5 and 6) is divided according to the three components of the framework; structural dimension, agential dimension, and the socio-technical provisioning. The data on agential dimension presented data on the age, education,

choice, land ownership, geographic location, and trust. The age of the participants shows that although relatively younger participants keen to use the mobile phones more often than face-to-face communication with the commercial contacts, the majority of the farmers who are in the age group between 45-55 prefers both face-to-face and mobile phones to communicate with their commercial contacts. The education of the rice producers highlighted the grass-root literacy (section 5.2.2) of the rice producers benefitted the rice producers to adopt mobile for commercial communication, however, the lack of English education led to the very limited use of SMS. The data on land ownership and choice also has a distinct impact on the use of mobile phones by the participants. The structural dimension shows the majority of the contacts of the participants are social contacts. However, the commercial content exchange (section 6.4.5) shows that the participants receive information on the price, seeds, fertilizers, and government announcements. The socio-technical provisioning shows the participants choice, and their network size (number of contacts), and frequency to have a positive trend. The critical analysis of their contact maps (section 5.3.3) indicates how the network between social and commercial contacts varies between the participants. The use of mobile phones in the harvesting period to communicate with commercial contacts (section 5.3.5) shows how the participants consider the mobile phones as a resource. The outcome of choice (section 6.4) shows that the participants consider the mobile phones important for their commercial engagement, therefore from a resource-based view, it is considered as a resource for the rice farmers. The financial benefit perceived by the rice producers (section 6.4.5) explains further how the participants relate their use of mobile phones to financially benefit them. There are also cases explained in the choice outcome section where the use of mobile phones is viewed as a tool in times of financial emergencies. This indicates their use of mobile phone for coping with the vulnerability. Applying the empirical findings to the framework shows each and every single agency influence on

the creation of their social and commercial networks. These varying influences of these different agency indicators changes the configuration in the provisioning (section 6.2). These different configurations create different types of resources for the participants. Figure 6.14 illustrates all these different indicators that have been discussed in chapter three, and analysed based on the data in chapter five and six. The diagram presented shows the way in which different elements influence the rice producers' communication that is directly addresses research question one. The entire framework also shows that the process of establishing networks, leads to information exchange and transformation to various forms of capital and resources, addressing research question two. The socio-technical provisioning that dictates the different forms of capital and resource creation addresses the third research question.

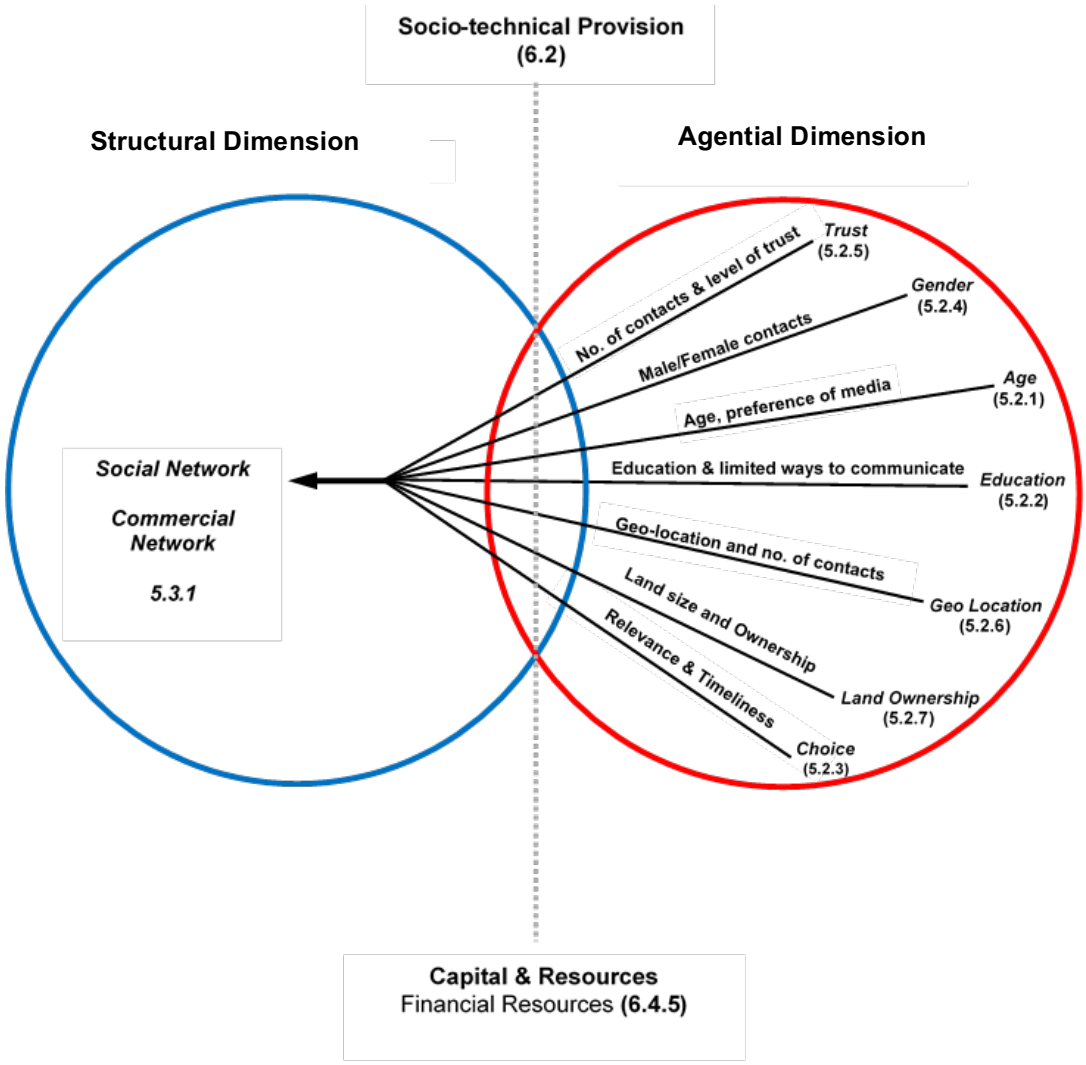


Figure 6.5 – Conceptual framework revisited

6.6 Chapter Summary

These rice producers as discussed, create both commercial and social capital. Therefore, the different forms of capital/research-creation are dependent on the different level of choice, institutional practices for the rice producers. This chapter provided the interpretation of the socio-technical provisioning that has been discussed in two separate dimensions. The agential dimension discussed the choice, preference, and belief of the rice producer that affect the use of their mobile phone. On the other hand, the structural dimension discussed the various forms of social and commercial contacts the rice producers create and the importance of their commercial content exchange. The commercial benefit the rice producers create has also been discussed in this section. The formation of provisioning brings these two dimensions together and creates the sociotechnical provision for the rice producers; the process by which communication leads to any form of resource or capital.

7. Conclusion

7.1 Research Overview

The primary objective of this research has focused on the use of mobile phones by the rice producers in Bangladesh. In literature, the impact of mobile phones as a medium is shown to be not entirely confined to commercial use, but is also relevant to general social connectivity, an integral part of the rice producers' primary mobile use. Although the research aims to highlight and assess the commercial benefits of mobile phone use by farmers, the social connectivity seemed to play a vital role in their commercial sphere.

From a networking perspective, the two factors of significance are the contacts and the mobile phone itself. Furthermore, it was also important to highlight the distinction between mobile communication, and face-to-face communication with the aforementioned contacts. As well as the immediate commercial gains, it was also necessary to acknowledge the relationship capital developed with government bodies, experts and fellow members of their profession.

Understanding the wider commercial contribution of mobile phones required the discussion of possible commercial outcomes, and the communication process that enables the rice producers to achieve their desired outcomes. The core theoretical components of this research discuss a number of theories relating to the network and the communication process. The principal framework of the research is founded on *structuration* theory. This divides the rice producers and their network into the structural and agential dimensions. The sociotechnical provisioning provides the link between these two elements, which reflect the different sub discussions elaborated in the background of the research (chapter two).

The basic premise of the research is grounded in the nature of mobile phone usage for both social and commercial connectivity. Theories related to network are applied in order to discuss the different types of networks that facilitate knowledge exchange for the rice producers, wherein the communication process mediates their knowledge creation. The characteristics of rice producers and their social/commercial contacts have been distinguished between agent and structure with regards to *structuration* theory. The theory of *choice* has been used to detail the varying use of mobile phones. The other theories about their preference of mobile phone use are explained through the *resource-based* view. Rice producers' communication with their social/commercial contacts for their occupational benefit is also explained through their institutional practices, which cover their existing commercial communication.

In parallel to the research objective, the research philosophy (chapter 3) elaborates on the ontology and epistemology of this research. The ontological foundation was established on the structuration theory that dictates how the reality of mobile phone use by the farmers is perceived by the researcher. The epistemology discussed how different theories such as choice, network theory, social capital, resource-based view and institutional theory provided the knowledge regarding the reality. This perspective of the research dictates the concepts discussed in the background of the research (chapter two). The ontological and epistemological perspectives led to the development of the framework of the research. Chapter three also discussed the background of the framework and how the related work influenced the framework of the research. The subsequent chapter (Chapter 4) provided the methodological outline of the research and explained the type of data that was necessary in accordance to the components of the framework. The chapter also discussed the sample size, data collection plan and the rationale for the mixed method approach for the study.

The results and findings of the research are divided according to the theoretical components (chapter five and six). Both survey and case studies captured the specific detail of the discussions related to network, age, education, trust, geolocation, and mobile usage preferences (choice) of the rice producers. The interrelationship between the variables was presented to provide the different level of choice of the rice producers about their communication with the commercial network. The data related to institutional influences shows the contacts the rice producers communicate with for commercial interest. The data related to knowledge creation and business completion is indicative of their commercial use of mobile phones. The data on agential dimension shows the rice producers' preference to communicate with varying commercial contacts. The creation of different types of capital and resources is therefore associated with their varying communication frequencies, preference and the nature of communication.

7.2 Addressing the Research questions

The findings and interpretations of the research are shown following the theoretical framework. The framework addresses the three research questions discussed in chapter one (section 1.3).

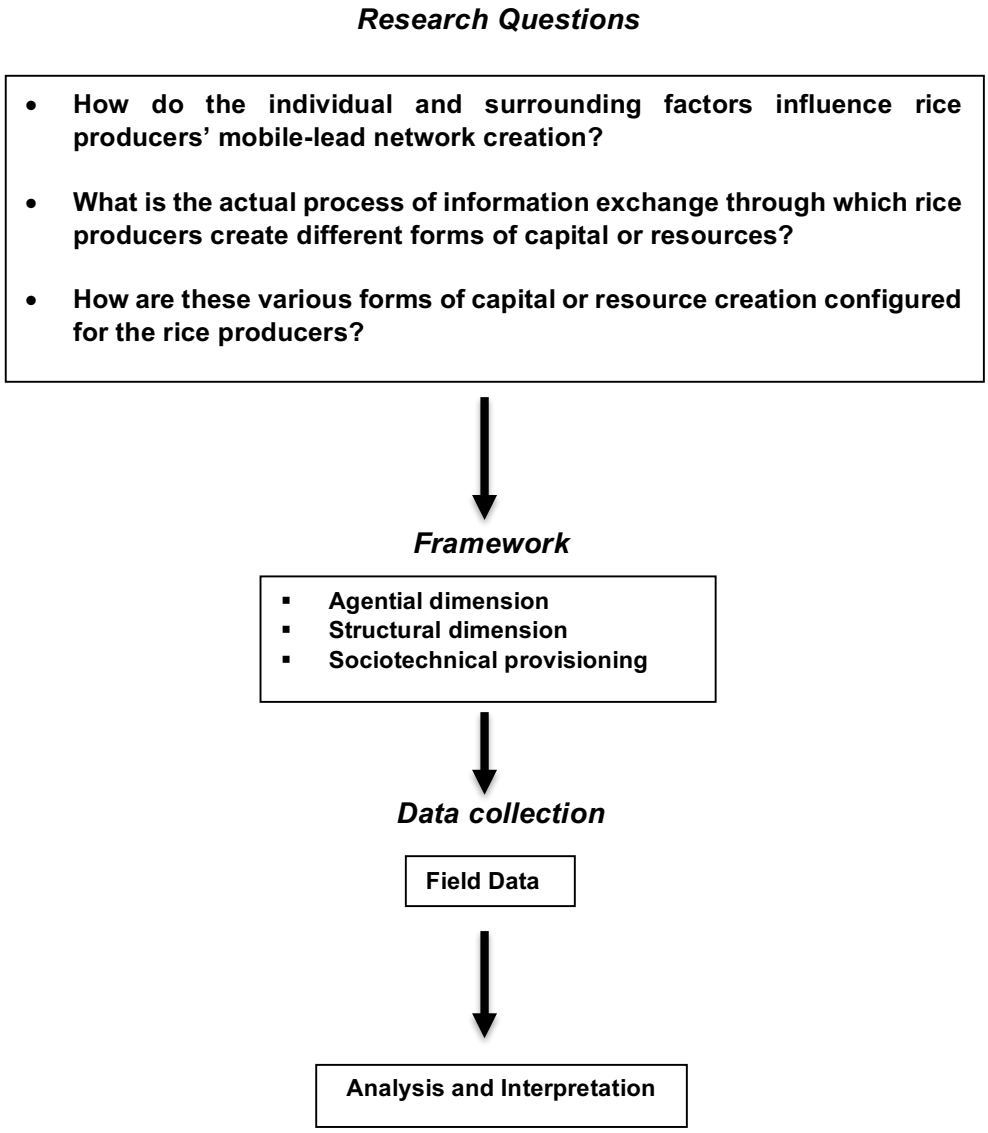


Figure 7.1 – Addressing the research questions

The first research question, enquires about the factors that influence the rice producers' mobile led network creation. These factors are broadly divided into two categories; agency and structure. The agency related factors are age, education, gender and choice. According to the findings and interpretations (Chapter five), the age influences the use of mobile phone producers to choose to communicate with their commercial contacts in a certain manner. The level of education also influences the rice producers regarding the number of commercial contacts they have on their phones. The gender data, although limited shows that the use of mobile phones has a positive impact on their general communication in terms of levels of awareness and obtaining knowledge (market information, seed related information, pest/disease related information). This obtained knowledge is linked with their commercial content exchange that allows them to conduct business using the mobile phones. Using this communication medium for commercial benefit provides a certain freedom (Sen,1999) as it facilitates their desired outcome.

The more the participants use mobile phones, the more their commercial utilization increases (Section 6.2), further enabling financial benefits for the rice producers. The knowledge of the participants is influenced by their information sources, where mobile phones play an important role in allowing the rice producers to communicate more frequently with their commercial and social contacts. The social connectivity also plays a role in driving the obtainment and creation of knowledge which also influences their commercial decision making, as reflected in the case studies. These inter-exchanges of local knowledge among the participants increases the human capital by creating and enhancing skills through information received on farming technology, the market and pest management.

The data related to choice shows the rice producers timeliness, relevance and importance metrics. These three elements independently influence how frequently the rice producers use the mobile phones and how many commercial contacts they have. This choice of the participants has two distinct sides. On one hand, as seen through their use for social connectivity, their connectivity with their family and friends intensified with the use of mobile phones. The case studies and the data on social contacts shows that the participants communicate both face to face and through the mobile phones with these social contacts. Therefore, there is a growing social exchange with their contacts. On the other hand, the commercial contacts also became closer by interacting more frequently for any commercial needs. Therefore, the rice producers within the influence of institutional practices that dictate the nature of the commercial contacts create a unique phone culture with their social and commercial connections that is different to their face-to-face connectivity. The gender differences as well as financial disparity influences their use of mobile phone (section 5.1). However, the freedom of communication is available for these vulnerable groups of farmers (landless and female) through their access to the mobile phones.

The female rice producers use the mobile phones for commercial purposes, that would otherwise not have been possible. This impact of the mobile phone is, therefore, having a far-reaching impact in terms of obtaining and creating knowledge and skills for the female farmers, and moving away from working only as in a supporting capacity in rice farming towards engaging in the decision-making the process of harvesting, buying and selling. The potentials of this knowledge creation of mobile phones are therefore resulting in creating commercial capital and financial capital for the participants.

Regarding structural factors, there are institutional practices and government bodies. The rice producers communicate with government bodies or extension agents both

face-to-face and remotely. These commercial contacts that are part of the informal supply chain are one of the factors that influence the rice producers' mobile phone usage. The government extension agents who oversee certain designated regions of the country are mechanisms for direct government intervention, and the rice producers receive valuable information through these contacts, as shown in relevant case studies. The participants showed their communication with the government extension agents for various information related to seeds, farming technologies, and government announcements. The influence of the government on these participants is difficult to measure purely from a communication perspective as there are many non-agricultural elements of the rice farmers that are dependent on government such as infrastructure, health, and financial support. However, all these elements directly influence their financial well-being. The research showed the impact of transportation for the farmers, which is also a major cost element of their commercial aspect. Specifically, their communication with an informal chain such as faria and beparies, which varies between participants depending on the strength of the relationships with these key actors in the supply chain. Therefore, there is a question of efficiency and effectiveness in their supply chain.

The structural dimension (section 5.2) shows the existence of these key players and the way in which these farmers negotiate price and network with them is very subjective and depends on the farmers financial and other obligations. The lack of institutional arrangements is also evident from the case studies where the opportunity cost data shows that the financial profit and loss is influenced by how efficiently these participants use mobile phones for their commercial purposes. Therefore, mobile phones create financial capital for those farmers who use them for aligning their supply chain to reduce the cost of transport and shorten their lag time for selling produce. Especially because their spending on transport costs shows how the informal

arrangement through mobile phones with the buyers has an important cost-saving implication for the rice producers.

The second research question is about the actual process of the rice producers' information exchange and the creation of capital or resource. The framework of the research addresses the information exchange process influenced by the agential and structural dimensions. The rice producers are influenced by their agential dimension. These factors dictate how the rice farmers perceive the commercial value. The mobile phones enable the user to establish relationships with their social and commercial contacts that is relevant to their commercial interest.

The rice producers' information exchange with their social and commercial contact that differs from participant to participant has distinct patterns. The commercial contacts that are specific to the structural dimension of the farmers dictate the nature of their contacts, i.e., the input sellers, buyers and the government extension agents. However, the SNA maps (section 6.5.1) that indicate their relationship pattern and choice show how mobile phones became a necessary tool for their day to day life. Although the existence of face-to-face communication is also part of their communication culture, the growing use of mobile phones for social or commercial communication is creating network capital that allows the farmers to gain access to resources according to their needs and use. This use is not only driven by the commercial benefit but also to cope with the crises related to financial and other emergencies. The case studies show the use of mobile phones provides support in the organization of agricultural aid. Therefore, the mobile phone has an important role to mitigate the livelihood shock. These emergencies are also linked with their agency attributes such as their financial circumstances. The unique pattern of mobile use among the farmers constructs the agential dimension. Although, within the pattern

that each rice producers create has a complex mechanism of self-interest, preference, and social or commercial priorities, the outcome of these different combinations always results in social or commercial capital for rice producers.

The data findings of the research showed the number of commercial and social contacts that the rice producers communicate with. Among the case study examples, there are rice producers who use the mobile phones more exclusively for social purposes compared to others. Subsequently, knowledge creation takes place as a result of the communication exchange between the rice producers and their social contacts. The findings (chapter 6) also show the nature of dyadic relationships between the commercial contacts and the rice farmers. These networks have certain characteristics that enable the rice producers to be able to communicate more frequently. Through these contacts, the rice producers not only create knowledge but also conduct commercial activities.

The findings of the research show rice producers' complete business transactions with their commercial contacts on the pricing of produce, transport, and determine quantity over the phone. During the harvesting and land preparation seasons, the data showed the communication with the input suppliers plays a fundamental role. Following this, the commercial interactions, and activities predominantly occur in the post harvesting phase of rice production. These commercial contacts are based on the structural and agential dimensions of the rice producers. Therefore, the second question of the research about the process that enables rice producers to communicate with the mobile phone and how that information communication translate to the resource is explained through the framework and the results of the presented data.

The third research question is about the different forms of capital and resources, and the way that their configuration becomes possible through the use of mobile phones. This question is addressed through the two components (agential and structural

dimensions) simultaneously. The intersect point between these two components creates sociotechnical provisioning, which provides the answer to the third research question. The provisioning brings the agential and structural aspects of the research together. These two elements represent the direct influences of the choice or preference of the rice producer and the existing commercial practices in conjunction. Based on their different level of preference to use the mobile phones in various ways, and their arrangement of the commercial network, the rice producers create different types of capital and resources.

The survey data showed that the rice producers communicate with commercial contacts, but do not necessarily carry out any commercial activities with them that lead to financial gain. Interactions with these commercial contacts however, does generate social capital. The rice producers who create long-term commercial dyadic relationship create commercial capital as they communicate in order to acquire commercial knowledge. The findings of the research showed that there are types of knowledge rice producers obtain, such as information regarding price, quantity, and the market. The findings also present data on the rice producers who create financial resources using the mobile phone. The case study data on opportunity cost shows the farmers saving transport and marketing costs by communicating with the market; buyers and suppliers.

The rice producers use of mobile phones for commercial purposes has shown to create commercial benefits not only by receiving commercial knowledge but also by the conducting of commercial transactions which has provides financial impact. The completion of business transactions by the rice producers includes the price, quality and transport arrangements. When a new dimension is incorporated within existing social practices, it is considered to be an innovation (Schumpeter, 1939). These transactions are adding a new attribute to the existing business patterns which is a

form of innovation for the rice producers. This innovation is creating an opportunity for rice producers by changing the commercial configurations for the rice producers through the addition of more commercial contacts which adds value by increasing commercial exchange and commercial transactions. The data showed the commercial content exchange leading to a number of commercial contacts that implies the 'duality' paradigm of Giddens (1984) in the way in which the rice producers as agents are changing the existing structure resulting in changing rules and resources for the farmers. These changes benefiting the rice producers to overcome the challenges of market inefficiency that exist due to lack of information and knowledge. The different types of capital and resources being created are dependent on the configuration of agential and structural influences on the rice producers through their use of mobile phones.

The configuration of their network that includes both social and commercial networks facilitates knowledge sharing between the actors. This socio-technical provisioning phase reflects the information exchange and dictates the different forms of capital and resource creation for the farmers. The participants based on their level of trust and preference communicate with social or commercial contacts for their required information where the network structure whether social or commercial is not the primary concern to the farmers. Therefore, from the network perspective, it is not about the number of ties for the farmer that facilitates commercial knowledge but the strength of their networks such as dyadic contacts that lead to the creation of capital or resource. This phenomenon of networks and their relation to the resources is therefore complex and that exists through their unique network creation capacity with social or commercial ties that are different from each other (section 6.2).

The rice farmers' efforts to diversify their network is also evident from the case studies where they connect with non-dyadic contacts to gain access to valuable trade

information, that from network perspective creates the bridging and shows the adaptive capacity of the rice producers. Through this network evolution, a deeper social or commercial relationship forms with the contacts such as shown in the case studies, and specifically in their dyadic multiplex relationship with commercial contacts. This changing nature of their relationship alters their provisioning state and potentially creates financial or commercial resources for the farmers. Within these networks, farmers establish a network hierarchy, where some networks are more frequently used compared to others. The case studies also suggested the existence of sub-groups within their network that the rice producers communicated with more frequently - these are the network that influence farmers decision-making and dictates their resource creation possibilities.

7.3 Contributions of the research

The research contribution is broadly divided into two streams; theoretical and practical. The research provided a framework based on the conceptual inputs that capture the influences on the rice farmers' network creation. The study developed and utilized a framework to understand the communication process of the rice producers that have an instrumental impact on their financial wellbeing. The structure required a methodology that reflects the theoretical concepts discussed in the literature review (chapter two). The data to elaborate and reflect the components of the framework was considered in order to understand and explore the varying use of mobile phones. Both survey and case study data support the analysis regarding the use of mobile phones, network types and preferences of the rice producers. In the following section, the theoretical and practical contribution of the research has been presented.

7.3.1 Practical contributions

The research illustrates the trade related information that rice producers use on a day to day basis. The rice producers communicate with commercial and social contacts to access this trade related information. According to this research, there are particular types of information such as market prices and input prices. There is also knowledge related to harvesting, land preparation and marketing that the rice producers require, and benefits their rice production. Based on the knowledge and information required, mobile based services can be developed by government or mobile phone operators that will be beneficial for the rice producers.

The government extension service provides regional support for the farmers in Bangladesh. According to Bangladesh department of agricultural extension (DAE, 2016), there are thirteen thousand employees working in different regions of Bangladesh. These extension agents can benefit from this research by providing relevant agriculture-related information and services to the rice producers. This research has demonstrated the implications of geographic distances between mobile based rural contacts and the commercial information required by the rice producers. The extension agents can benefit from this understanding, and in particular from the known radius of information circulation. From a network perspective, this may help in better planning of area coverage. Furthermore, primary data on the rice producers' stated requirements with regards to price, transport, market and trade related information can also be relayed through these government officials as an addition to the existing farming and seed related information. This would aid farmers in receiving reliable information, from reliable sources and make more well informed decisions. However, the use of this knowledge and application to a wider area requires policy level intervention. The policy implication of this research includes a further investigation on the region specific formal and informal supply chains, and their

efficiency in managing price volatility of produce and market information delivery to the rice producers. According to Bangladesh government ICT policy (BTRC, 2002) the government intends to take initiatives that enables ICT application in agricultural business development. However, currently the policy approach does not consider the network that the rice producers create, both social and commercial, which are major sources of information for them and have a direct impact on the government interests to facilitates the farmers. This research provided certain findings such as the role of peer-to-peer communications among farmers and how network building varies with land ownership, education and gender. Therefore, the information delivery requires a targeted approach where these different groups can be identified and provided with relevant information on the market by the government.

This framework is meant to provide a basis to analyse the different forms of capital and resources generated by the rice producers. The research can be further extended by creating an index of the factors (agential and structural) that impact the rice producers' mobile network. This index can be created based on the social use and commercial use. These different types of data can be linked to the commercial transactions mentioned in section 5.2. Based on the index, it is possible to quantify the exact nature of the capital and resources the rice producers are creating through mobile communication. To quantify the impact of mobile phone usage for commercial purposes, the percentage of mobile phone usage in communicating with the commercial contacts, for commercial activities, can be specifically isolated and compared with face-to-face communication from the overall communication. Another example of indexing can be segregating the knowledge creation between social contacts and commercial contacts. This separation between the two will enable specific identification of the types of knowledge being created by them. The measurement of financial resources or commercial capital creation however, is possible only through extensive research and requires institutional support. The ministry of agriculture in

Bangladesh can conduct this research and use the knowledge from the data to provide information services through the extension agents by creating mobile-based networks with the rice producers. This might also require training and support for the extension agents on the use of mobile phones and information that needs to be relayed that allows the rice producers to create financial resources using mobile phones.

The research shows the impact of seasonality on mobile phone use by the rice producers, namely the nature of their commercial use. The input supplier or buyers can use this information to provide further services for the rice producers based on this changing requirement. There are multinational agricultural companies such as *Bayer* and *Syngenta* that operate in different regions of Bangladesh. These companies use marketing professionals to collect information on the needs of the rice producers. This research can provide relevant information on field level knowledge sources for the rice producers for their own business planning and supply chain management, which may positively impact their service towards the rice farmers. These findings are useful not only for the input suppliers but also for the farmer's cooperatives to provide timely and helpful mobile phone based support. The associated bodies such as international NGOs that provides support to the rice producers can also benefit from creating an informal mobile-based network with the rice producers and provides information based on their seasonal demand.

The research provides an insight into the network creation process of the rice producers of Bangladesh. The structural dimension shows the commercial practices that dictate the limitation of the network creation by the rice producers. This research introduces a framework that incorporates the theories that have been utilized independently to understand the impact of the mobile phone on the rice producers. Further data can be gathered from the same participants over a period to explore how the number of commercial contracts, commercial contents and the opportunity cost

changes for these rice producers. These longitudinal data can be applied using this research framework to explore how specific resource creation is possible for the rice producer. These data on the number of contacts can be beneficial for the mobile network service provider to be able to know the patterns of the rice producers' mobile phones usage, such as call durations, frequency of SMS usage. Based on this mobile phone usage behaviour, the service providers can design special tariffs that may be beneficial for the rice producers and profitable for the operators by expanding their customers base among farmers.

7.3.2 Theoretical contributions

There is an increasing amount of emphasis in ICTD research in order to provide assessments for the various interventions by international NGOs. Most of the existing research focuses on understanding how the mobile phones impact a wider group of people in developing countries. Although valuable in their contribution towards providing a broader understanding in the field, agency funded studies may be prone to influence by a background agenda and setting of priorities. The scientific approach in this kind of research commonly uses a control group to conduct the experiment by comparing between the mobile phone users and non-users to assess the various indicators. These assessments are then analysed based on the results obtained from the collected data, to explain the impact. However, the complexity of the assessment rises with the attempt to analyse and explain the individuals' motives for using mobile phones, along with their intentions. To be able to capture the inner complexity within the network of the rice producers, this research segregated the users from their social and commercial contacts. From an ICTD perspective, this type of research to explore the relationship dynamics between the rice farmers and network building with their commercial contacts is novel. Duncombe (2016) conducted a review of the 46 articles published from 2000 to 2013 in the area of agriculture and rural development

incorporating mobile phones. These research projects were carried out in countries such as India, Uganda, Kenya, Nigeria, Tanzania, Niger, Philippines and Bangladesh. Based on these studies Duncombe, highlighted the urgency of future research in considering both explanatory theories and predictive theories, as the latter commonly involves narrowly selected indicators.

By explanatory theories, Duncombe referred to the theories that emphasize the explanation of network or social capital that provides a causal relationship between their resource creation and use of ICT. This research on the mobile communication of the Bangladeshi rice farmers' addresses explanatory theories through the implementation of structuration, choice, and network theory. The predictive theories according to Duncombe (2016) are those research that emphasize micro-economic analysis, such as the relationship between transaction costs and market failure. In this research, the use of the frequency, timeliness, and importance of communication with commercial contacts has been linked to the commercial benefit. According to Duncombe, the use of explanatory theories that provide a framework which considers the broader problems of rural development such as information accessibility and transportation cost that can be resolved using mobile phones, is scarcely covered in the existing literature. His findings further indicate a gap in understanding the role of institutions and their link with the farmers in those countries. In this research, the institutional practices and the knowledge transfer through these institutions in Bangladesh has been shown.

As Duncombe states:

"Ideally, theoretical approaches should combine both explanatory and predictive power, and these constitute what Merton (1968) terms mid-range theories and according to Weber (2009) they should be preferred as they tend to be neither too broad nor too specific, and are abler to articulate relationships that hold across a range of contexts."

(Duncombe, R., 2016, pp 229)

This research acknowledges the individual rice producers' attributes and preferences that influence their decisions in network creation. These individual measures such as age, education, trust, geolocation each individually affect the rice farmers' decision. However, all these different indicators are also part of a bigger picture where the institutional practices and social interconnections between the rice producer and their commercial contacts play a role. This research uses structural and agential factors to provide a holistic picture of the rice producers' network building. Therefore, from the ICTD research perspective, it provides a comprehensive and broad analysis of the impact of mobile phone for the rice producers, and not a partial understanding.

Within the circumstances of network and the agency/structure influences, the rice producers exercise different levels of choices which are not independent of these influences. This spectrum of choice is incorporated in this research through examples that indicate its presence in the decisions of the rice producers that influence the network. The research shows the application of *choice* theory in a complicated socio-technical dimension that provides a rigorous understanding of the nature of mobile phone use by the rice producers. The framework of the research used the institutional practices to specify rice producers' commercial practices. This framework is adaptable for other types of farmers or professionals by changing the profession specific practices, and is therefore, applicable for analysing the ICT use of professionals in other developing countries, with varying institutional practices.

7.4 Research limitations

This research is limited by its scope and objective. The background presented the rice producers in Bangladesh facing severe adversity from growing population, pests, diseases, lack of credit and natural calamities such as flooding. Information and communication can resolve some of these challenges that the rice producers face, such

as price volatility, lack of information on pest and diseases, government subsidies, access to quality seeds, fertilizer and new farming technologies.

Enabling the resolution of these issues however, is also dependent on policy level interventions. Government intervention and support is required in the form of providing a standardized supply chain, context specific arrangements such as seed distribution to the majority of the rice producers, access to finance and the provision of good physical infrastructures such as roads and transportations. Nonetheless, information and communication technology plays a significant role in rice producers' commercial benefit. The role is not limited to the commercial network creation, but also it enables access to government information and social connectivity. Specific to this research, there are limitations that were inevitable, and are discussed below:

1. The research considered several theoretical elements and different types of data (survey and case studies). The agential and structural factors provide critical input for the framework and are also capable of providing extensive details on the impact of mobile phones on the rice producers. This research utilized a number of theories (*choice, structuration, network* and *institutional)* and applied them to field data, in order to provide a comprehensive understanding of the nature of mobile phone use by the rice producers. The restriction lies in the practical limitations in identifying and gathering data on more relevant factors that may have a measurable influence.

2. The research was designed to provide a holistic overview of the network creation and its impact on commercial aspects of rice producers. The research conducted a mixed method approach. Emphasis on quantitative analysis would have allowed a regression model to show the dependencies with the structure and agency relationship. However, lack of panel data on the use of mobile phones makes it difficult to establish the relationship and dependencies on the variables. Furthermore, due to time limitations, it was not possible to create an index on the questionnaire, which could have been developed to gather longitudinal data for a year.

3. The mobile phone data, which was initially planned to be collected from the mobile phone operator was not possible because of the strict government decreed customer data protection act. Therefore, the research had to organize a limited volume of the mobile phone data from the selected nine participants of the research. Therefore, the frequency and duration of mobile phone data are available for only two seasons – not for a whole year.

4. To conduct intensive research on the social network analysis on the rice producers' mobile network all the data related to their communication were necessary. Within the selected case studies, the detailed breakdown of their communication data was not available because the mobile phone operators do not keep the details of their connection time and call duration data. Therefore, industrial quantitative social network analysis tools were not possible to utilize for the rice producers mobile-based network.

5. The research considered a representative sample of the rice producers. To reflect on the gender influences access to more female rice producers would have given a richer understanding on their mobile phone use. However, most of the female rice producers are involved in the supporting associated activities related to the rice production such as storing and processing. The case studies found only one female farmer, who participated in the rice cultivation process in the field. Therefore, the research could not capture or use statistical analysis on female rice producers of the impact of the use of mobile phone, due to the limited sample size.

6. There is not much research in the space of ICTD that combines the theoretical analysis of the network and the agency impacts on the use of mobile phone for rice producers. Lack of such studies made the research difficult to compare with any empirical findings, and set qualitative benchmarks. The actual impact findings provide benefit by comparing with existing research with similar research objectives.

7.5 Possible further research

The research presented a process through which the rice producers of Bangladesh create capital and resources using mobile phones. The findings of the research

identified the individual influences of the factors that are coherent with the framework. The framework and the findings provided the basis for further work in the space of ICTD. Future research possibilities based on this research are presented below:

1. The framework is specifically defined for the rice producers. The commercial practices of rice farming and seasonality have been addressed in this research. However, the framework has the potentials to understand the impact of mobile phone use for other professions. The change in institutional practices and the profession specific commercial network would recreate frameworks applicable to any other profession and location.

2. The factors such as choice have a broad implication in the use of mobile phones. Kleine (2010) utilized the choice framework on Chilean rural users of telecentre facilities and showed the impact on the users. Similarly, the choice framework can be utilized solely on a representative number of rice producers to explore how their desired outcome of using the mobile phone is materialized through the results they obtain. Using the choice framework on the rice producers to incorporate with the framework of this research may provide a better understanding of the exercise of mobile phone use by the rice producers.

3. The possible conversion of the resources has been presented in the research. Further study on the process of conversion would explore the exact nature of conversion between different types of resources by the rice producers.

4. This research showed the mobile phone usage data for nine participants. The data contained information on the pre-harvesting and harvesting seasons. A data set for a whole year that includes the data on their time durations would enable an extensive research by conducting detailed statistical network analysis on the patterns of mobile phone use and the network created by the rice producers.

5. A comparison of mobile phone use by the rice producers from different geographic locations would provide insight into the geographic variation in their use of mobile phones.

7.6 Chapter Summary

This chapter provided the overview of the research with a brief discussion on all the chapters. The significance of the research provided both academic and practical contribution to the research. The limitations of the research provided an understanding of the boundaries in understanding of the study. The future scope discusses other possible implications of the framework and how this work can be further advanced. The purpose of this study was to understand the varying nature of the rice producers' mobile phone usage, and how they create knowledge and networks. The theoretical components provided the foundation to analyse different factors and how they influence the rice producers. The research brings together different theories that support the context, and provides a holistic understanding of the impact of mobile phones in the creation of different forms of capital and resources by the rice farmers in Bangladesh.

Appendix

I. Questionnaires for research

Name		
Age:		
Sex:		
Education Level:		
Number of Contacts in Phone:		
Number of Commercial Contacts:		
Daily use of mobile on an average:		
Ratio of commercial to social use	1. 20 80 2. 40 60 3. 50 50 4. 40 60 5. 80 20	
Commercial contacts in priority order	1. Seller 2. Buyer 3. Transport 4. Govt. or other agencies	
Number of commercial contact Whom you contact on a daily or weekly Basis	Between 1-5	If more, take the detail explanations
How does your major supplier, buyer contact you?	1. Mobile 2. Face to Face 3. Landline 4. Other 5. Both mobile and face to face	
Ranking your top 5 contacts number based on the frequency of call, contact Which commercial contact comes first and in what order?		

II. Case Study and Survey Questionnaire

Enquiries	Responses	Response code
The number of contacts		
The number of commercial contacts		
The top 5 commercial contacts		
Geographic location of the commercial contacts	1. ½ miles-1 miles 2. 1 to 3 miles 3. 3 to 5 miles 4. 5 miles and over	
The frequency of communication[1]	Last 1 year Log	
Duration of the communication	Last 6 months' log	
The importance of the information shared with the commercial contact[3,5]	1. Very important 2. Important 3. No so important 4. Not important	
With mobile phone do you have more commercial contact than before? How many commercial contact increased since last year ?[2]	1. Less than 5 2. 5 to 10 3. 10 to 20 4. 20-30 5. 30 -40 6. 40-50 7. 50 +	

Actor	
Commercial Contact	
Type of commercial contact	
Frequency [1,6] 1. Every year 2. : Every 6 months 3. Every 3 months 4. Every month 5. Every fortnight 6. Every week 7. Daily	
Information relevance to commercial aspect[3,5] 1. Not at all 2. Slightly useful 3. Average 4. Quite useful 5. 5. Very	
Timeliness of Data from the contact[4] **6.** Never **7.** Rarely **8.** Sometimes **9.** Almost always **10.** Always	
Trust[9] 1. Not at all 2. Some trust 3. Average trust 4. High trust 1. 5. Complete trust	
For Commercially important information, do you use mobile phone to communicate? What other media you use?	

What is your farm size		
Who are your buyers?	1. Local traders 2. Distributers 3. Shops from city etc.	Any other type will be noted
Who are the suppliers?		
Where are these buyers and sellers situated?	Distance from the farm In miles	
How often do you contact suppliers?		
How would you describe the commercial contacts benefited you in your business		

III. USAID-MPower farmer query data set

Case fact-sheet 01

Name of the farmer	Kamrul
Address	Baladanga
Sex	Male
Information required	Pest and disease
Crop	Rice
Season	Aman
Area of cultivation	1 Acre
Type of Soil	Etel
Type of Soil	High-land (After heavy rain, the water does not retain more than twenty hour hours)
Do have cultivation facility	Yes
Type of breed	Br10
Visible problem	Pests
Where do you see the problem in the crop?	Lower side
How many days these problem persisted?	10
Did you use any fertilizer, medication?	No
Have you noticed same problem in your neighbouring field?	Yes
How much of your land affected by it?	0.3 acres
Have you noticed same problem with same crop before?	Yes
Do have a drainage system in your land	No
Have you irrigated your land?	Yes
Photo of the problem	

Date	Query reply by	Comment
11-Sep-14	Local extension agent as a reply to the query	Have to clean the weed, dry the land and irrigate again. Have to use Propiconazole (Tilt 250 EC or Akonazol 250 EC @ 40 ml). Have to use every fifteen days along with potassium (10 KG) in two terms.

Case fact-sheet 02

Name of the farmer	Pralad Dam
Address	Durbasury mulia narail
Sex	Male
Information required	Pest and disease
Crop	Rice
Season	Aman
Area of cultivation	2.4 Acre
Type of Soil	Gutisunno
Type of Soil	High-land
Do have cultivation facility	No
Type of breed	Br10
Visible problem	Pests
Where do you see the problem in the crop?	Roots
How many days these problem persisted?	15
Did you use any fertilizer, medication?	yes
Have you noticed same problem in your neighbouring field?	Yes
How much of you land affected by it?	0.8 acres
Have you noticed same problem with same crop before?	No
Do have a drainage system in your land	No
Have you irrigated your land?	Yes
Photo of the problem	

Case Fact-sheet 03

Name of the farmer	Kamrul Hasan
Address	Barakpur
Sex	Male
Information required	Environment and flood
Crop	Rice
Season	Aman
Area of cultivation	2.1 Acres
Type of Soil	Etel Doash
Type of Soil	Medium-high (after heavy shower, water remains in the land for two-three weeks)
Do have cultivation facility	No
Type of breed	Local red breed
Stage of cultivation	Initial phase
The type of disaster information required	High tide
The information you require?	Preparation for high tide
Did you take and precaution?	No
Do have a drainage system in your land	No
Have you irrigated your land?	No
Photo of the problem	

Date	Query reply by	Comment
10-Sep-14	Local extension agent as a reply to the query	There is a water-lock in the land, the farmer need to do some other crop

Date	Query reply by	Comment
8th Aug-14	Local extension agent as a reply to the query	Have to use potassium every fifteen days. Also require pesticide such as falikul one millilitre in one little water. Can also use Contaf -01 / mili little in one little water.

Case Fact-sheet 04

Name of the farmer	Nazrul Huq
Address	Jugihati
Sex	Male
Information required	Pest and disease
Crop	Rice
Season	Aman
Area of cultivation	1.2 Acre
Type of Soil	Etel
Type of Soil	High-land
Do have cultivation facility	No
Type of breed	Bina 7
Visible problem	Leaf dryness
Where do you see the problem in the crop?	On the leaf
How many days have these problem persisted?	7
Did you use any fertilizer, medication?	No
Have you noticed same problem in your neighbouring field?	Yes
How much of your land affected by it?	0.10 acres
Have you noticed same problem with same crop before?	Yes
Do have a drainage system in your land	Yes
Have you irrigated your land?	No
Photo of the problem	

Date	Query reply by	Comment
08-Sep-14	Local extension agent as a reply to the query	Affected by grasshopper. Have to kill the grasshopper visibly. Allow the birds to come and eat the grass hoppers. If its affects over 15% of the land use pesticide.

Case Fact-sheet 05

Name of the farmer	Md Asaik Khan
Address	Marka kaliganj satkhria
Sex	Male
Information required	Better Irrigation technology
Crop	Rice
Season	Aman
Area of cultivation	3.2 acres
Type of Soil	Etel
Type of Soil	High-land
Do have cultivation facility	No
Type of breed	Brre-54
What type of irrigation technology do you want to learn?	Intermediate nursing
Where do you see the problem in the crop?	On the leaf
How many days have these problems persisted?	7
Did you use any fertilizer, medication?	No
Have you noticed same problem in your neighbouring field?	Yes
How much of you land affected by it?	0.1 acres
Have you noticed same problem with same crop before?	Yes
Do you have a drainage system in your land	Yes
Have you irrigated your land?	No

Date	Query reply by	Comment
24-Sep-14	Local extension agent as a reply to the query	1. Keep water two-three centimeters in the plantation of the seeds. 2. Ten days after the plantation three to five plantation. 3. Use hands to take out the weeds. 4. After rain have to stop using urea fertilizer.

Case Fact-sheet 06

Name of the farmer	Md Jinnat Shikder
Address	Charkalikapur
Sex	Male
Information required	Environment and flood
Crop	Rice
Season	Aman
Area of cultivation	1 acre
Type of Soil	Bele Doash
Type of Soil	Medium-high (after heavy shower, water remains in the land for two-three weeks)
Do have cultivation facility	Yes
Type of breed	Aman
Stage of cultivation	Second layer
The type of disaster information required	Heavy rain
The information you require?	Preparation for after heavy rain
Do you have a drainage system in your land	No
Have you irrigated your land?	Yes
Photo of the problem	

Date	Query reply by	Comment
N/A	No answer provided	N/A

Case Fact-sheet 07

Name of the farmer	Al Mamunmamun
Address	Amtoli
Sex	Male
Information required	Pest and disease
Crop	Rice
Season	Aman
Area of cultivation	3 acres
Type of Soil	Etel
Type of Soil	Medium-high land
Do have cultivation facility	No
Type of breed	Brre 49
Visible problem	Yellow leaf
Where do you see the problem in the crop?	On the leaf
How many days have these problems persisted?	5
Did you use any fertilizer, medication?	No
Have you noticed same problem in your neighbouring field?	Yes
How much of your land is affected by it?	0.1 acres
Have you noticed same problem with same crop before?	No
Do have a drainage system in your land	Yes
Have you irrigated your land?	Yes
Photo of the problem	

Date	Query reply by	Comment
26-Aug-14	Local extension agent as a reply to the query	Water has to be drained within five to seven days and then irrigate again. The weed has to be cleaned.

Case Fact-sheet 08

Name of the farmer	Bokul
Address	Kapasati
Sex	Male
Information required	Fertilizer related advice
Crop	Rice
Season	Aman
Area of cultivation	3.4 acres
Type of Soil	Doash
Type of Soil	High land (water does not sustain more than two days after rain)
Do have cultivation facility	Yes
Type of breed	Supar
Type of breed used immediately before	Second layer
Have you used any fertilizer in the immediate previous crop?	Yes
Have you used any bio-fertilizers? What did you use?	Yes, Cow dung
Which fertilizer have you used previously on this soil?	DSP

Date	Query reply by	Comment
01-Sep-14	Local extension agent as a reply to the query	When the seed ages in 30 days, use urea seventeen kg.1st instalment use 8.5 kg and in the 2nd phase use 8.5 kg.

Case Fact-sheet 09

Name of the farmer	Md Zakirul Hossain
Address	Varashamla Kaliganj
Sex	Male
Information required	Advance farming technology
Crop	Rice
Season	Aman
Area of cultivation	2 acres
Type of Soil	Etel Doash
Type of Soil	High land
Do have cultivation facility	Yes
Type of breed	BR 49
What particular stage of farming technology do you want to learn?	Second layer
Have you used any fertilizer in the immediate previous crop?	Sowing seeds and the initial phase
Please provide details	For BR 49, how long should I keep and what should be the distance between the seeds.

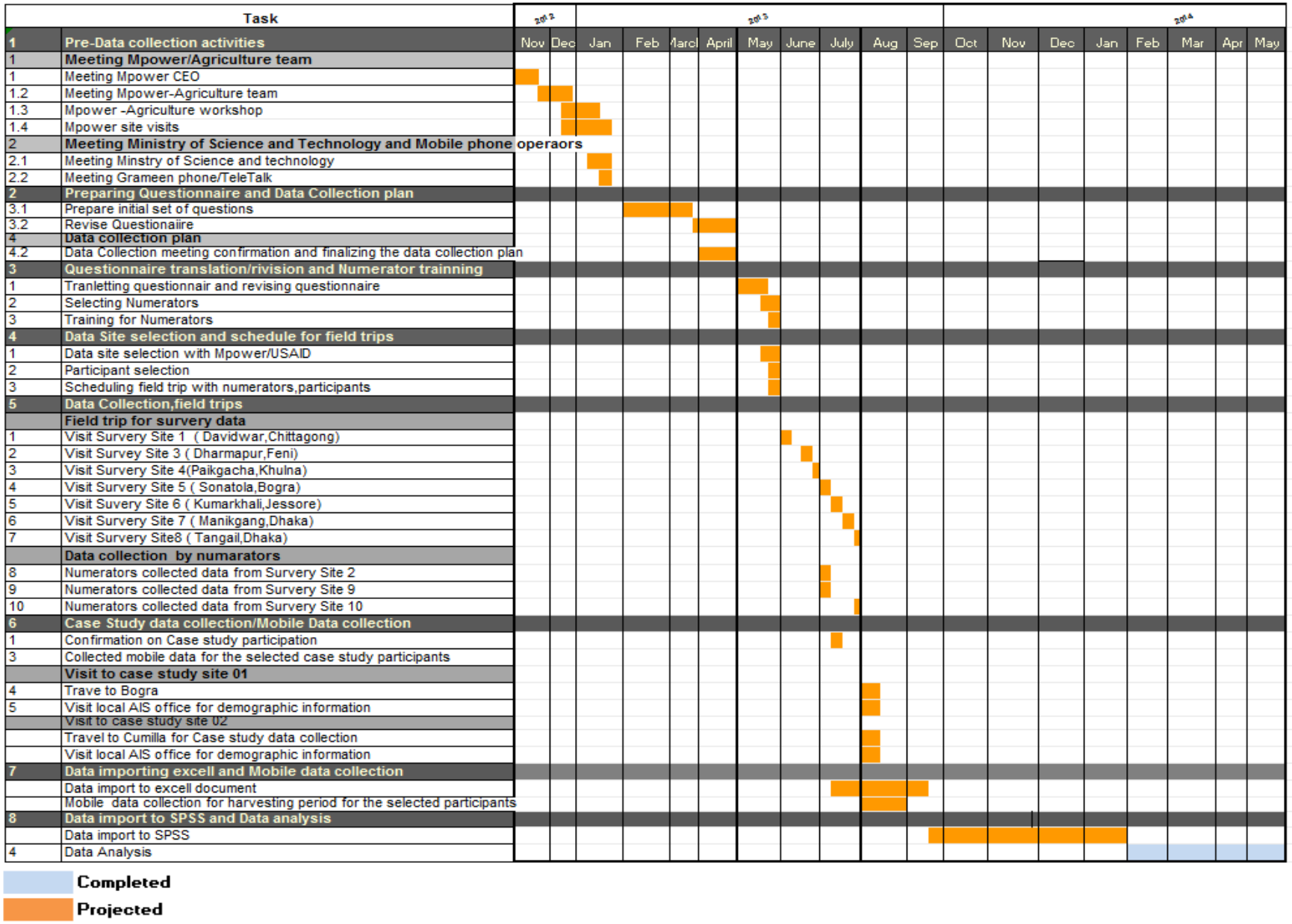
Date	Query reply by	Comment
05-Aug-14	Local extension agent as a reply to the query	For this breed, the rice seed should be 25-30 days old for sowing. The distance should be 8 inch by 8 inch.

Case Fact-sheet 10

Name of the farmer	Shohag
Address	Charkalikapur
Sex	Male
Information required	Weed related management
Crop	Rice
Season	Aman
Area of cultivation	3 acres
Type of Soil	Bele Doash
Type of Soil	High land
Do have cultivation facility	Yes
Type of breed	Aman
Please state your problem.	There are lots of grass, vadla in the field
Have you taken any measures for the weed problem? What did you use?	Yes, Don't know the name
Has there been any recent rainfall in your location?	No

Date	Query reply by	Comment
14-Aug-14	Local extension agent as a reply to the query	Have to use water to soften the soil to be able to pick the weed manually. Use Pretilachlor 500 EC, Clear 500 EC one liter per hector. Once the water is dried, the land needs to be irrigated.

IV. Project Gantt Chart



V. Case Studies

Case Study One

Name: *Mr. Dipon*
Location: *Alisar, Sadar south, Comilla*
Age: 33
Education: Level *5*

Background

Mr. Dipon has been living in this location since birth. His father worked as a farmer, and through his family, he inherited 0.4 acres of land. He lives with his wife and three children. His eldest son, who is in higher secondary school, helps him with the rice production. His land is considered to be high-land, which allows him to grow rice in three seasons. The rice types are Aus during in July-August, Aman during November-December, and Boro during April-May.

Communication with social and commercial contacts

Mr. Dipon has a total of sixty contacts on his phone. Among this contacts list there are fifteen commercial contacts and forty-five social contacts. The social contacts mainly consist of friends and family. Mr Dipon started to use the mobile phone in 2005. The social use of mobile telephony is for communicating with his brother who works in the city and other family members who live in different parts of the country. Although the majority of the participant's friends live in the same village, Mr. Dipon uses mobile telephony to communicate with those friends for regular social interaction and sharing information. Commercially, the mobile phone is utilized for their information needs at different phases of rice production.
Network and Communication

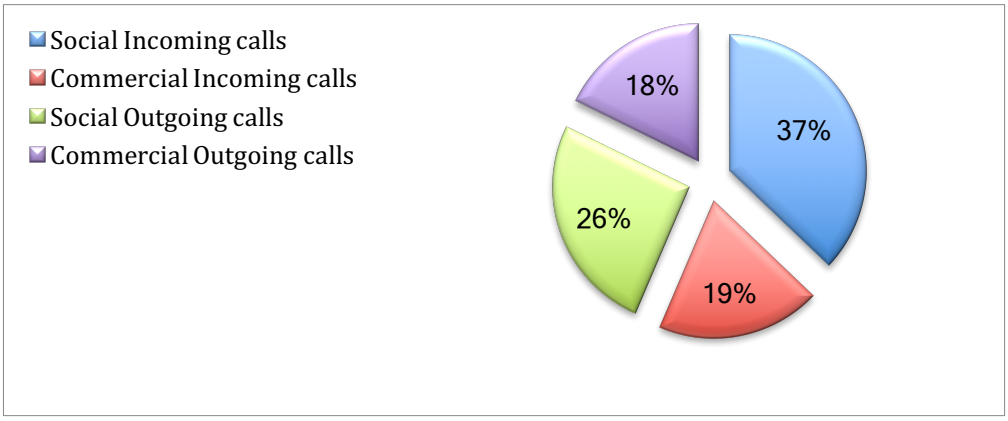
Mr. Dipon believes that using the mobile phone is very Important for him. According to the participant, the mobile telephone has greater importance compared to other media. The reasoning for this importance refers to the 'mobility' factor (Surabhi & Tripathi, 2009) that allows the participant to communicate with his contacts at any time or place as the need arises. Along with the importance comes the question of 'trust' regarding information through mobile phones. According to the participant, the information he received through the mobile phone is trustworthy. When presented

with the options of communicating with the people he solely communicates with by mobile phone because of the distance, the participant would still trust the information provided by the commercial contact that lives beyond his physical reach. This trust explains the 'strong ties' with commercial connections (Molony, 2006). The participants presented a scenario of an unexpected water-lock situation in the land that required physical assistance from the other farmers. Communicating with the day labourers during harvesting season is another common use of mobile phone for the participant.

When compared with other media for communication, such as the radio, TV and landline, the participant does not compare the TV or radio in as the same way as mobile telephony. According to the participant, the TV is more about entertainment. However, the participant mentioned particular TV shows and radio programmes that have agricultural contents that are beneficial.

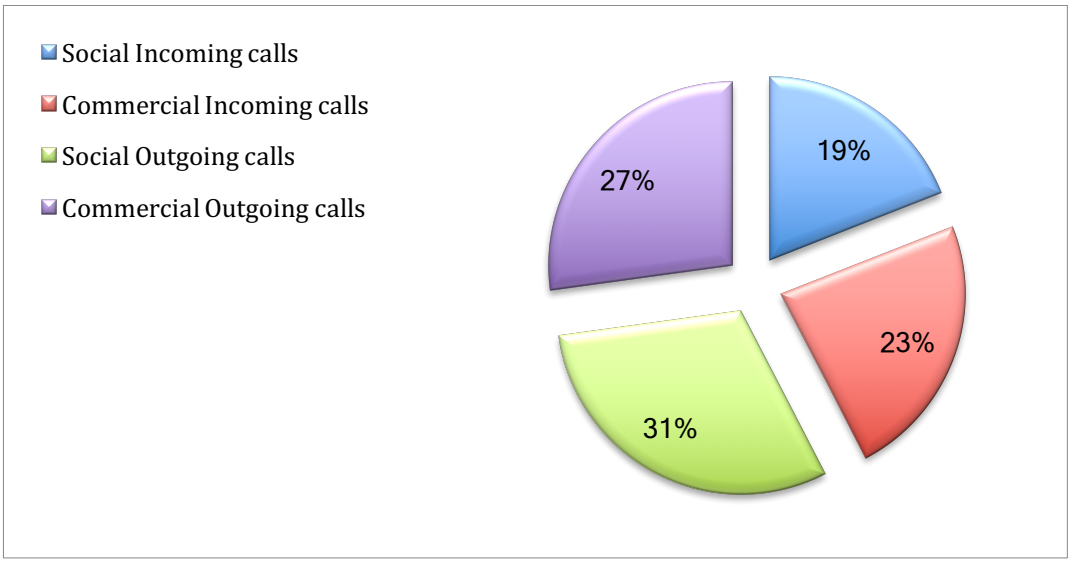
The benefit from using mobile telephony also brings up the discussion of the uses for mobile phones on a daily basis. The participant uses mobile phones on average for one to two call per day. According to the participant, these calls are made to both commercial and social contacts. The calls per day vary during three different phases: harvesting phase, land preparation phase and lean/between crop phase. Mobile phone data for the lean season (June 2013, before Aush harvesting period) and the harvesting season (July 2013, Aush harvesting season) has been collected. During the pre-harvesting phase, there were a total of seventy-two incoming calls and fifty-nine outgoing calls. Among the incoming calls, there were forty-six social calls and twenty-four commercial calls. Among the outgoing calls, there were thirty-two social calls and twenty-two commercial calls.

Mobile-based communication during lean season



There are 63% of calls for social communication, compared to 37% of commercial calls. In the harvesting season (July 2013), there were a total of eighty-two incoming calls and one hundred seven outgoing calls. Among the incoming calls, there were a total of thirty-five social calls and forty-three commercial calls. Among the outgoing calls, there were fifty-six social calls and fifty commercial calls.

Mobile-based communication during harvesting season

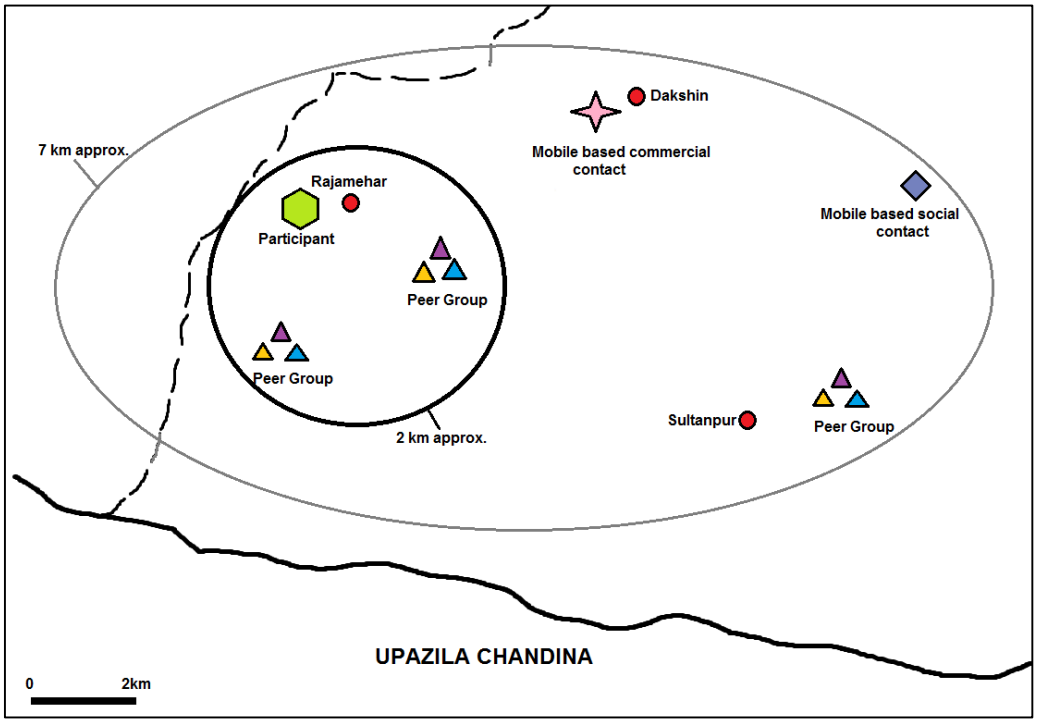


When questioned about how he would distinguish the importance between social communication and commercial communication, the participant believe that both were important, as the contacts are all connected with each other. This social arrangement is a reflection of the research conducted on sustainable rice farming by Roy et al. (2013), where it showed that social capital is an integral part of sustainable rice preproduction in the rural part of Bangladesh.

The communication pattern during the three phases of rice production (as discussed in the literature review) shows that the number of calls during the harvesting and post-harvesting phases is on average 3-4 per day, compared to 1-2 calls a day in the lean period. The calls during land preparation, according to the participants, are from 2-3. During the harvesting and post-harvesting season, the need for the calls is mainly related to sales and marketing. The participants also use mobile phones to learn about producers' prices in different markets. In the land preparation phase, this number is slightly lower because the information needed during the season is mostly related to fertilizers and seeds. During the lean period, the participant's calls are related to fertilizers and contacting the government extension agent to learn about the new information regarding their producers' prices, the new breed, etc.

Contact Map

The first participant lives within two kilometres of the Rajamehar Bazaar- a village market in the district of Comilla. Most of his immediate family and friends live within two kilometres of his outreach.
However, the commercial contacts are more distant, living within 7-10 kilometers. For the contacts that are within 2-3 kilometers, the participants prefer 'face to face' for communication. The contacts that are beyond three kilometers distance are contacted primarily by using a mobile phone.

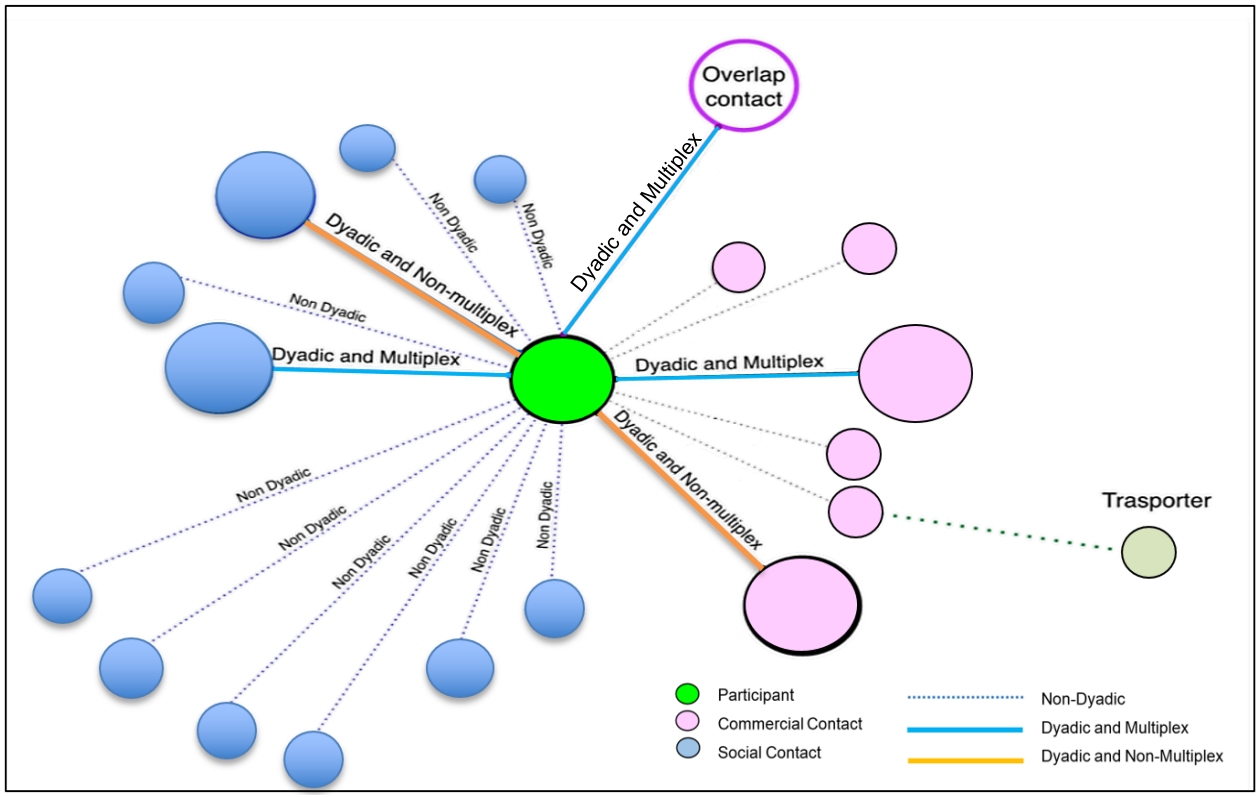


Nature of network

The first participant has a total of sixty contacts on his phone. Among this contact-list there are fifteen commercial contacts and forty-five social contacts. The social contacts mainly consist of friends and family. The participant started to use his mobile since 2005. The social use of mobile telephony is primarily for communicating with his brother who works in the city and other family members who live in a different part of the country. Although the participant's friends live in the same village, he uses mobile telephony to communicate with those friends for regular social interactions and share information. Commercially, the mobile phone is utilized for their information need at different phases of rice production. Therefore, the social communication is the primary use for this participant.

Along with the number of contacts in the mobile phones, the physical network also influences the participant's social network. However, the questions of this research were particularly focused on the network built through mobile telephony. There were questions regarding the participants' commercial contacts and social contacts. According to the participant, the mobile phone had enabled him to be able to communicate more frequently to the same contacts than before, which led to more reciprocity. This particular medium in this case means more intimacy, intensity, and association-therefore creating strong-ties for the participant. From a network analysis perspective, the type of network (weak or strong) centrality refers to how far or close the participant is from the other nodes in the network (Freeman, 1978). Another aspect of the network that is discussed in the following section is the multiplexity of network. Among the social and commercial contacts, the participant communicates with some of the contacts with both face-to-face and mobile telephony. These are friends and commercial contacts that are socially closer to the participant. The information received from these individuals is regarded as highly trustworthy according to the participants. These are contacts the participants mentioned in his most frequently communicated individuals. Among the social contacts, one is a cousin who is involved in rice production, and the commercial contacts are input suppliers in the local market. Therefore, the frequency of communication and 'trust' makes them the 'dyad' relations of the participant. From a 'centrality' perspective, the participant has a number of contacts on his mobile phone who are resourceful for his commercial engagement. There are contacts such as the agricultural extension agent, Block supervisor (government officer) and local input traders. However, the participant does not frequently use his contacts even in the time of urgency. When questioned about why these resources are not being utilized frequently, the participant rather 'feel' confident about the close tie contacts with whom he frequently communicates.

SNA Map



Among these close social contacts, the cousin who is in the same trade discusses their common commercial interest such as buying the seed for both from BADC (local government seed supply agency), hence the relationship involves commercial and social exchange, which is the multiplexity nature of the network. Similarly, the particular commercial contact who has become socially close also formed multiplex dyadic network. Similarly, the overlap contacts share similar property of these contacts. Other commercial and social contacts are not dyadic, since these contacts are not that close to the participant. The transporter, who is not directly related to the participant but contactable through a wholesaler-therefore it is a contact through weak relationship tie belong to a different network, which is the 'structural hole' of the participant's network.

The participant believes that communication is very much central to his profession, which requires regular communication with the relevant people involved in rice production. According to the 'social cognitive theory', (Bandura, 1986) an individual who is constantly interacting with the people around him is influenced by his social milieu. From that perspective, the network that he created influences the participant's perception. Referring to the response on 'trust' of the mobile-based communication, there is a general perception of the participant that the information he receives

through the phone is ‘good.' This perception affects the participant in terms of classifying the phenomenon of information through the mobile phone as ‘good’ (in a good or bad comparison) according to affect control theory (Heise, 1979). This influence forms the belief that leads to action by accepting the information using the mobile phone for trade engagements of the participant.

The participant was questioned about the increase of commercial contacts from last year. According to the participant, there were two new commercial contacts added this year. This includes the local faria, who offered a better price in the 2012 Aman season. Therefore, the commercial network for the participant is need-based. The social contacts, however, are more open to more family and friends. When questioned about the types of buyers and sellers, the participants mentioned that the buyer group includes the local buyer, Faria and wholesaler from the market nearby. The suppliers of the participants are the local seed and fertilizer supplier and the BADC (Bangladesh government seed supplying agency).

The mobile phone of the participant has both social and commercial contacts (explained in the previous section), and these contacts create the network that has both local people and people who live far away from the participant. These contacts or connections that the participant communicates with through the mobile phone increase interactions and construct social or commercial structure.
There are farmer's club that the participants regularly attend, and this club is a form of a social structure that provides valuable input for the farmer. Along with the clubs, the government agricultural ministry organizes other road shows and events that the participant takes part in. The club and the government extension agent keeps a directory of the phone numbers of the farmers to contact. So the communications from these different agencies form the commercial structure that the participants interact with.

Choice

The participant’s number of contacts on his mobile phone, which are also his commercial and social connections, is an example of how the participant chooses to create the networks. When asked how frequently he uses the mobile phone, he mentioned 2-3 times a day (detail explained in the early section). This interaction is due to his decision to communicate with his social or commercial contacts to discuss specific needs at that time. According to the participant, the mobile telephony allows him to be able to communicate with his social/commercial contact instantly. This sense of mobility is referring to the existence of choice as mentioned in the framework described by Dorothea Klein (2010). Although the participant has many commercial contacts, he chooses certain individuals whom he prefers to communicate with when

need arises, which is his 'use of choice.' The communication with the dyad commercial contact results in the exchange of information. As the participant puts his trust in the information and acts on it, this becomes an 'achievement of choice.'

Costs associated with mobile phone and financial benefits

The participant spends nearly 1200-1500 taka (GBP 10-13) every two years for the mobile handset and on an average 200 Taka (GBP 1.30) per month for the subscription. When questioned about the financial benefit perceived by using the mobile phone, the participant believes that the transport cost associated with travel is vital for him. Particularly in a time of emergency, the mobile phone is an invaluable tool for communication. Similarly, the commercial benefit is intangible, where the participant communicates with the contacts that are dependent on the market and opportunity. In an answer about the recent sale, the participant mentioned 184 kg produce was sold to a wholesaler with 26 thousand to (GBP 200). The participant communicated using the mobile phone when confirming the price and dates. The cost associated with the call was on average 6-10 taka (6 pence). So, the communication with the transporter and the buyer together was less than 12 taka (8 pence).

Case Study Two

Name: *Mr. Babu*
Location: *Monihor pur, Sadar south,Comil*la
Age: *45*
Education: Level *3*

Background

Mr. Babu has lived in Monihor for for the last 25 years. Coming from a farming family, Mr. Babu has been working for other farmers for over a decade. The participant took a lease on a 1.2-acre plot of land. He lives with his wife and four children. The land that Mr. Babu leased is considered low-land, which allows him to grow rice in three seasons. The rice types are deep-water rice (July-August), aman (November-December) and boro (April-May).

Communication with social and commercial contacts

Mr. Babu has a total of thirty-two contacts in his phone. Among these contacts in his phone, there are five commercial contacts and twenty-seven social contacts. These social contacts mainly consist of friends and family. Mr. Babu began to use the mobile in 2008. The social use of mobile phones includes calls from friends and his eldest daughter, who lives in the nearby village.

Network and Communication

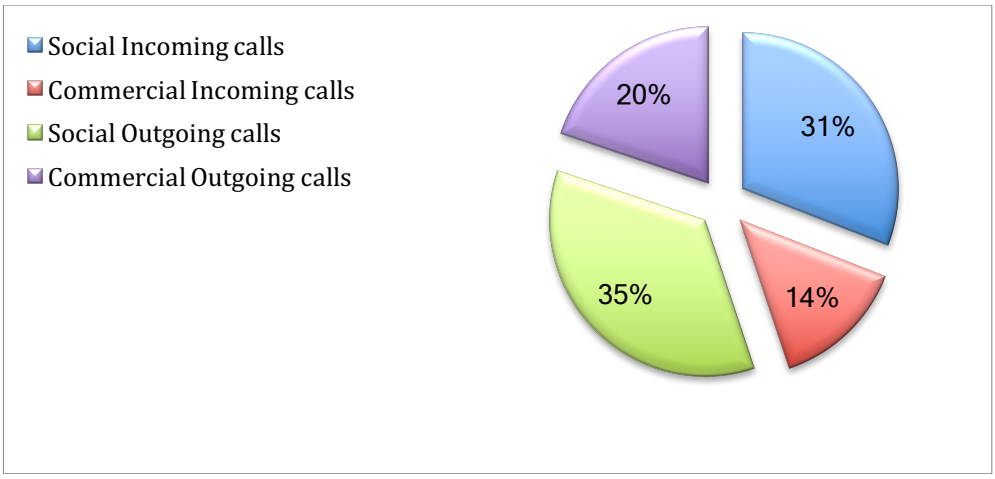
Mr. Babu believes that using the mobile phone is important for him. He believes that it is important because it allows him to contact other farmers easily, irrespective of their social and economic differences. As an example, one of the participant's friends is considered as the lead-farmer of the village. The participant believes that being accessible through using the mobile phone allowed him to be able to communicate with this particular farmer more frequently. There is a sense that a mobile phone allowed him to break the existing socio-economic partition that has been existing (Puro,2002). When questioned about the 'trust,' the participant believes it is rather the people who he chooses to communicate with by phone that play a vital role, which allowed him to fully 'trust' the information through the mobile phone. In terms of social contacts, the participant communicates with the people whom he is socially engaged with. He does not consider the mobile phone to add any benefit from a social connectivity perspective, since most of the social contacts are within a commutable distance. However, he believes that the mobile phone allows him to communicate frequently with the existing social contacts.

> "Trust comes from the people I choose to connect with, the mobile phone is just a means to contact"
>
> - Babu

Regarding the question of other media, the participant uses the radio more frequently than the mobile phone. The participant believes that the radio provides vital information related to his rice production activities. The participant has some access to television, which is not as effective as radio, according to the participant.

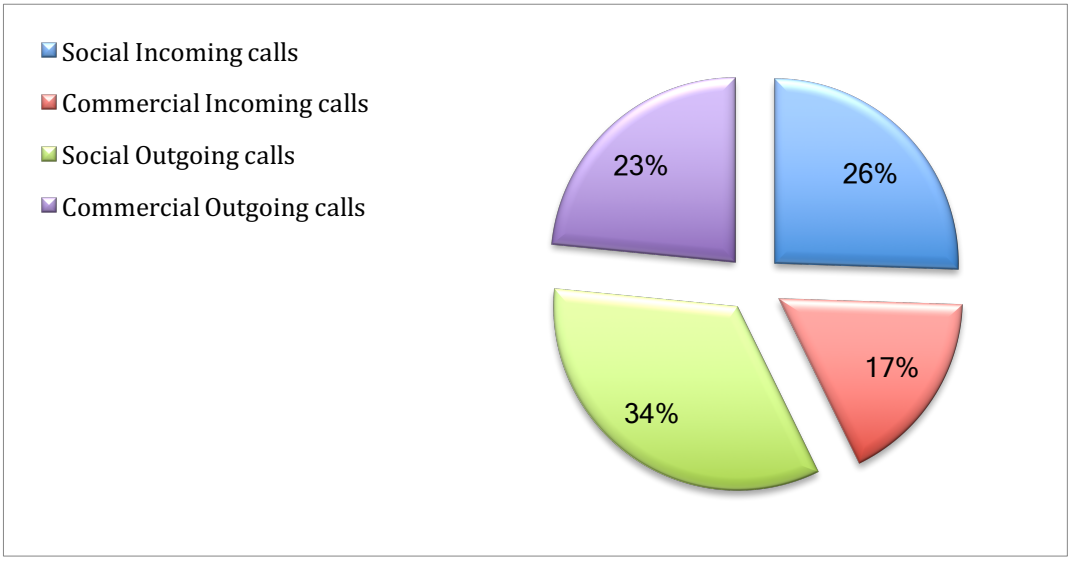
Mobile phone data of the participant has been collected for the lean season (June 2013) and harvesting season (July 2013 for Aush). During the lean period, there were a total of seventy-nine outgoing calls and sixty-three incoming calls. Among the outgoing calls, there were forty-eight social calls and twenty-seven commercial calls. In the incoming calls, there were forty-two social calls and nineteen commercial calls.

Mobile-based communication during the lean season



There were 66% of calls for social communication during the lean period, compared to 34% commercial calls. During the harvesting season, there were a total of eighty-seven outgoing calls and sixty-two incoming calls. Among the outgoing calls, there were fifty-four commercial calls and thirty-one social calls. Within the incoming calls, there were twenty-seven commercial calls and thirty-three social calls.

Mobile-based communication during the harvesting season



There was a total of 40% of calls for commercial communication (incoming and outgoing calls), compared to 60% of calls for social communication during the harvesting season. Based on the pattern of the communication between social and commercial contacts, the participant utilizes his phone mostly for social interactions.

Mainly, social contacts seem more frequent than commercial contacts. Social phone calls do not consist of many different contacts, and there are a limited number of social contacts with more frequent calls to these numbers.
As mentioned in the methodology section, the scope of this research does not allow the researcher to learn details about the nature of the participant's social communication. Therefore, the reasons for the frequent communication with the selected social contacts are unknown.

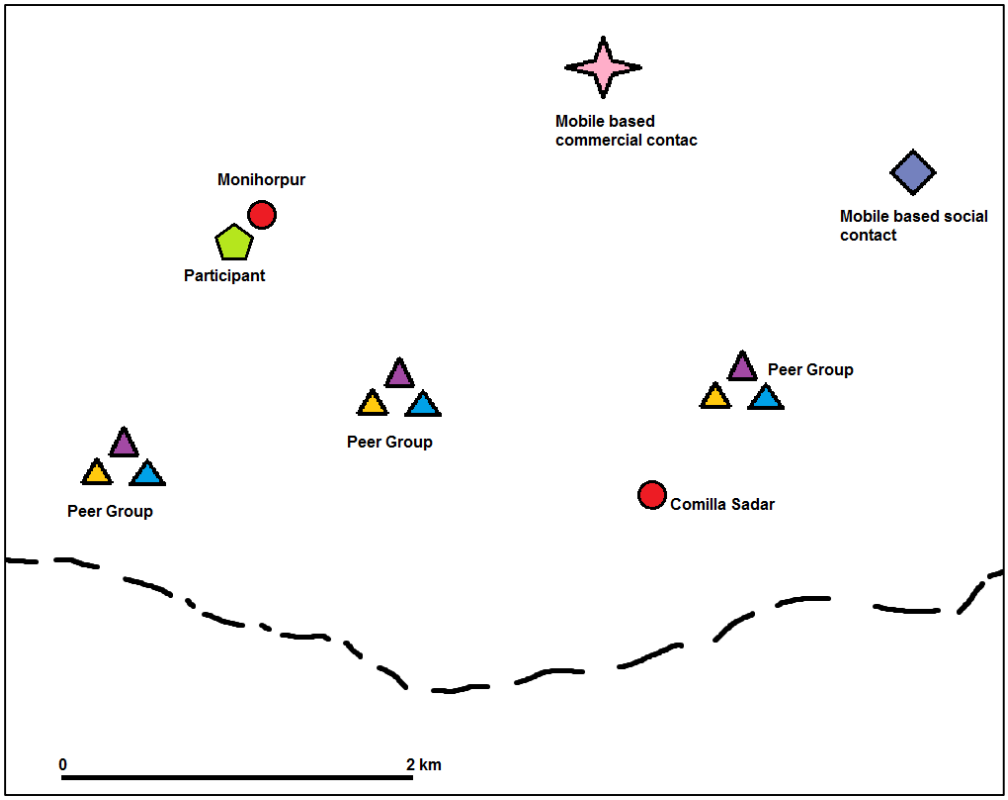
The communication pattern during the three phases of rice production do not differ much, as evident from the commutation patterns between the lean season and harvesting season. According to the participant during the land preparation phase, the calls that are made to the local suppliers on average are one to two per week. In the lean season, the calls were made to pre-arrange the sales or any input required for the paddy field. During the harvesting phase, the calls increased to three to four times a week because of the pricing information of the produce.

Social Network Analysis (SNA)

The second participant lives in Monihorpur, in Comilla. The participant has his social and commercial contacts within a radius of one to three kilometers. However, the commercial contacts and some other social contacts span from four to ten kilometers. The participant prefers 'face to face' for communication for the contacts that are within one to three kilometers.

Nature of Network

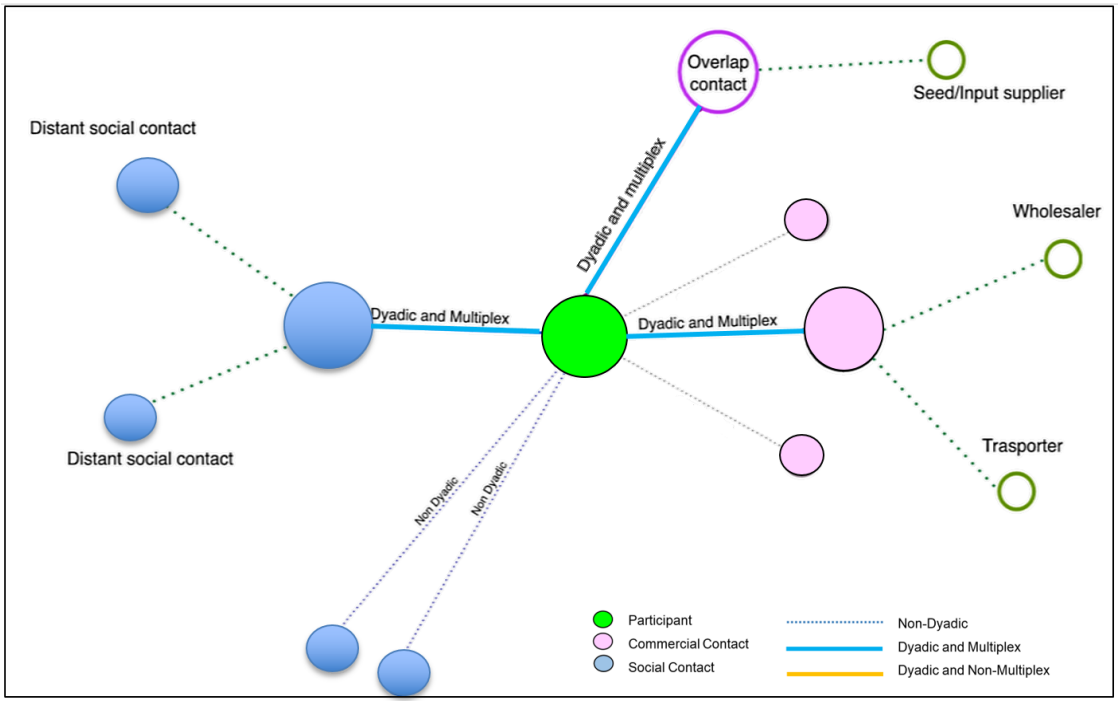
The second participant has a total of thirty-two contacts on his phone. Among these contacts in his phone, there are five commercial contacts and twenty-seven social contacts. These social contacts mainly consist of friends and family. The participant began to use his mobile from 2008. The social use of the mobile phone includes calls from friends and his eldest daughter who live in a nearby village. The commercial contact consists of the input supplier and local buyer.



According to the participant, the mobile phone is utilized to communicate with the people whom he described as 'close contacts' along with those whom the participant does not consider as 'close contacts.' This close contact by participant's definition, are those contacts whom the participant interacts frequently compared to other contacts. When questioned about his communication with distant contacts, whom the participant does not contact that frequently, Mr. Babu believes this is the advantage of having a mobile phone that allows him to communicate with them as well. From a social network perspective, the participant uses mobile telephony to communicate with both strong-ties and weak-ties. The mobile telephony enhances the ability of the participant to maintain both types of ties. This was also shown by a research by Goodman(2005) on the Tanzanian small medium enterprises. However, his finding shows, a majority of the participants use mobile phone to communicate with 'weak ties. In the example of Mr. Babu, this is rather the opposite of what was discovered

by Goodman (2005), where he used mobile phone predominantly to maintain his communication with 'strong ties.' In terms of 'centrality' of the network, the participant's network is closed to a limited number of people, by choice. According to the participant, it was his preference to keep the contact numbers to a minimum and manageable sum. The participant's mobile handset has the capacity to store one thousand contacts. However, the participant does not use handset memory, he memorises the last three to four digits of the contact to be able to communicate with the contact. Since he received limited formal education, he does not know how to spell and store names in his mobile phone. Therefore, level of 'education' influences the number of contacts the participant knows. Consequently, the degree of centrality in the contacts by mobile telephony is affected.

SNA Map



Based on the social network of the participant, he has some selected social and commercial contacts and overlap contacts that are friends and cousins in the same profession. However, his 'dyadic ties' with these contacts also share both social and commercial exchange. As described the participant, the social contacts who are close to him, on occasions request the participant to assist in their fieldwork. There are also the commercial 'dyadic' contacts, with whom the participant regularly communicates, these contacts in turn becomes socially close to the participant; therefore, the relationship contains both professional and social interaction which is the multiplexity in the networkInvalid source specified..However, the participant has some social and commercial contacts whom he prefers to approach through the immediate contact.

This could be an actor such as a wholesaler to whom he sells his produce jointly with one of his dyad commercial contacts. Similarly, along with an overlap contact, the participant purchases seed, fertilizer from a distant supplier.

Agency

Discussed in the earlier section, the participant prefers using the mobile phone and access to other forms of media such as the radio, which he believes is useful for his rice production. The participant finds the mobile telephones convenient for communication despite the majority of his contacts are located within commutable distance.

The participant considers his decision to buy a mobile phone was first influenced by his surroundings. However, his decision to create the particular type of network links was by choice and 'habit.' According to the participant, he started to communicate with the individuals when emergencies occurred, as he believed it to be useful during those circumstances. During other times, it became rather a 'habit' to communicate and contact them for trade or social matters. This practice causes the behaviour by communicating with the social ties as the participant feels necessary. In research by Fleetwood (2008), it has been discussed how habit is linked with behaviour that also acknowledges the choice, which is in this instance influenced by the confidence that the participant has about the ties in the time of his urgency.

Structure - government agencies, groups formed by buyers or sellers, peer-groups

The participant created a dyadic network that is crucial for his commercial and social linkages. Instead of communicating with the different parties, such as a transporter, by himself, the participant communicates through the dyad commercial contact. Although not directly, the participant communicates with the extended commercial contacts such as government agencies, government seed suppliers and wholesalers through the immediate contacts. Therefore, the structure, such as government agencies, or extended commercial contacts, such as wholesalers, have an indirect influence on the participant.

Choice

According to the participant, he uses a mobile phone two to three times a week. The participant believes the device is useful to emphasize or strengthen the relationship with the existing social or commercial contacts. The use of the mobile phone, according to the participant ,is restricted to the close-tie network that he created. The participant considers the mobile phone as a device to strengthen these relationships; therefore, it is the existence of choice for the participant. As he uses the mobile to communicate and contact his network for any particular purpose, there is a sense of

choice for the participant. The participant mentioning how he used the 'transporter' or the wholesaler through the dyad network is the 'use of choice' for the participant.

Costs associated with the mobile phone and financial benefits

The participant spends nearly 1000-1200 taka (GBP 9-12) every two to three years for the mobile handset. Mr. Babu spent on average 100 Taka (GBP .80) per month on the mobile phone bill. When questioned about how the commercial calls are linked to his business, from a financial point of view, the participant mentioned that for last 4-5 years in three seasons he used the same buyer, who is personally related to one of his 'commercial dyadic contacts.' Therefore, in every season, there is a direct relationship with his phone calls to commercial contacts. In the example, a participant mentioned that the income from the last boro season a gross profit of 70,000 taka (GBP 400), and the costs were 52,000 Taka (GBP 315). There were no added marketing costs other than the phone calls, which cost him 10-15 taka (GBP .10-.15).

Case Study Three

Name: *Mr. Shopon*
Location: *Boro Para, Sadar south, Comilla*
Age: *43*
Education: Level *5*

Background

Mr. Shopn has lived in the Boro Para location since birth. Faeming has been in the family for generations, and he owns 1.2 acres of farming land. He lives with his four children and elderly parents. The participant has the lowland with mainly two season of farming, Aman and Boro.
Communication with social and commercial contacts

Mr. Shopon has a total of 140 contacts on his phone. A total of 37 of these contacts are commercial contacts. The social contacts consist of the family, extended family and friends who live in distant locations. The participant began to use the mobile phone in 2004. According to the participant, he uses the mobile phone to communicate with the government extension agent about any farming-related suggestions. The

regular communication with the government agents also allows the participant to keep updated on the government subsidies, new seeds, fertilizers related news. There are three overlapping contacts, two friends who farm in the neighbouring land and his brother-in-law who is in rice production.

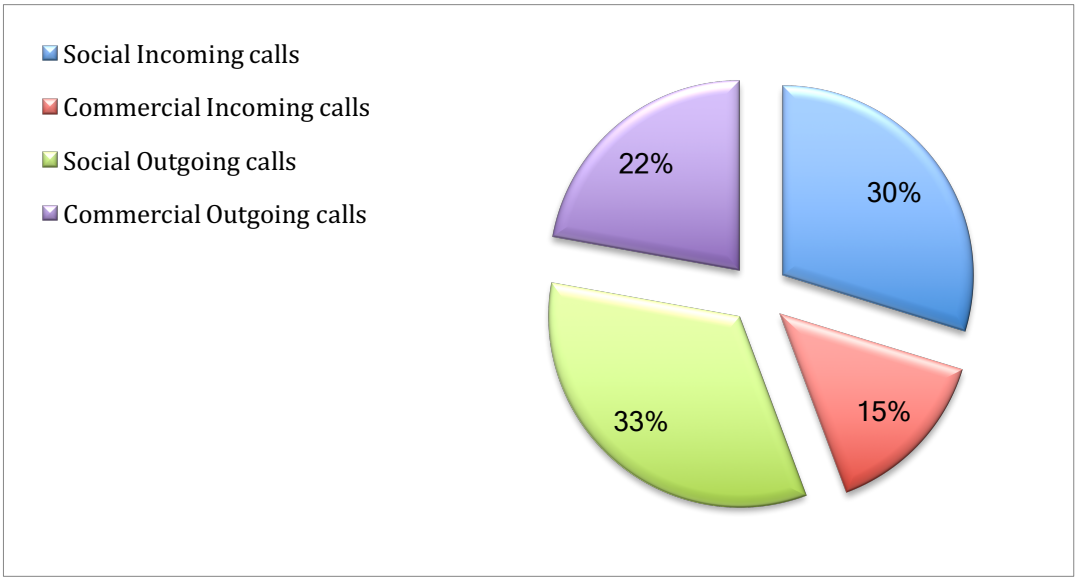
Network and Communication

Mr. Shopon considers the mobile phone 'very important' for his day-to-day operations. According to the participant, the phone is particularly useful because for two reasons: frequent communication with the government extension agent and to communicate with the distant commercial contacts that are commercially beneficial for the participant. This importance of communication with the government extension agent also has been discussed in the research by Aker (2011), regarding how the farmer's information needs are served by the extension agents and particularly
by the adoption of technology.
The other use of mobile telephony by the participant is for communication with the distant commercial contacts. This communication with remote commercial networks is also linked with the level of trust for the network and the information received through mobile telephony.

The participant trusts the information from the commercial contact by communicating with several other commercial contacts that are capable of providing similar information. The participant gathers the price-related information mostly from commercial contacts from different distant markets. The received information, according to the participant, does not differ very much.
The participant does not consider different forms of media such as radio, TV or the mobile phone in similar lights. According to the participant, although the landline has similar features, because of its expense and immobility he never had any access to one . The television and radio, according to the participant, are important sources of information but not as valuable and relevant as the mobile phone. The participant provided an example of a radio show that recommended br 47, a special breed for land that cannot produce in Aus season. However, the participant talked to the extension agent and learned that the particular breed of rice is not suitable for his land type. Therefore, the participant does not find media such as radio as useful and effective as mobile-based communication.

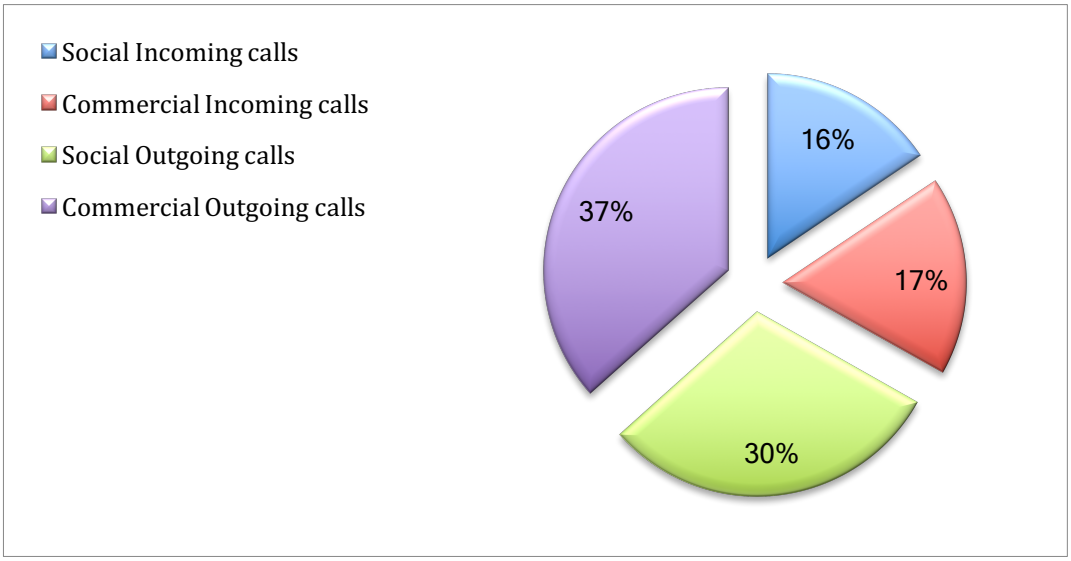
Mobile phone data has been collected for the lean season (June 2013) and harvesting season (July 2013 for Aus).During the lean period, there were a total of one-hundred and five outgoing calls and eighty-three incoming calls. Among the outgoing calls, there were sixty-two social calls and forty-one commercial calls. For the incoming calls, there were fifty-five social calls and twenty-seven commercial calls.

Mobile-based communication during the lean season



There were 63% of calls that were for social communication during the lean period, compared to 37% of commercial calls. During the harvesting season, there were a total of one hundred and forty-four outgoing calls and sixty-seven incoming calls. Among the outgoing calls, there were thirty-five commercial calls and twenty-eight social calls. Among the incoming calls, there were twenty-seven commercial calls and twenty-two social calls.

Mobile-based communication during harvesting season



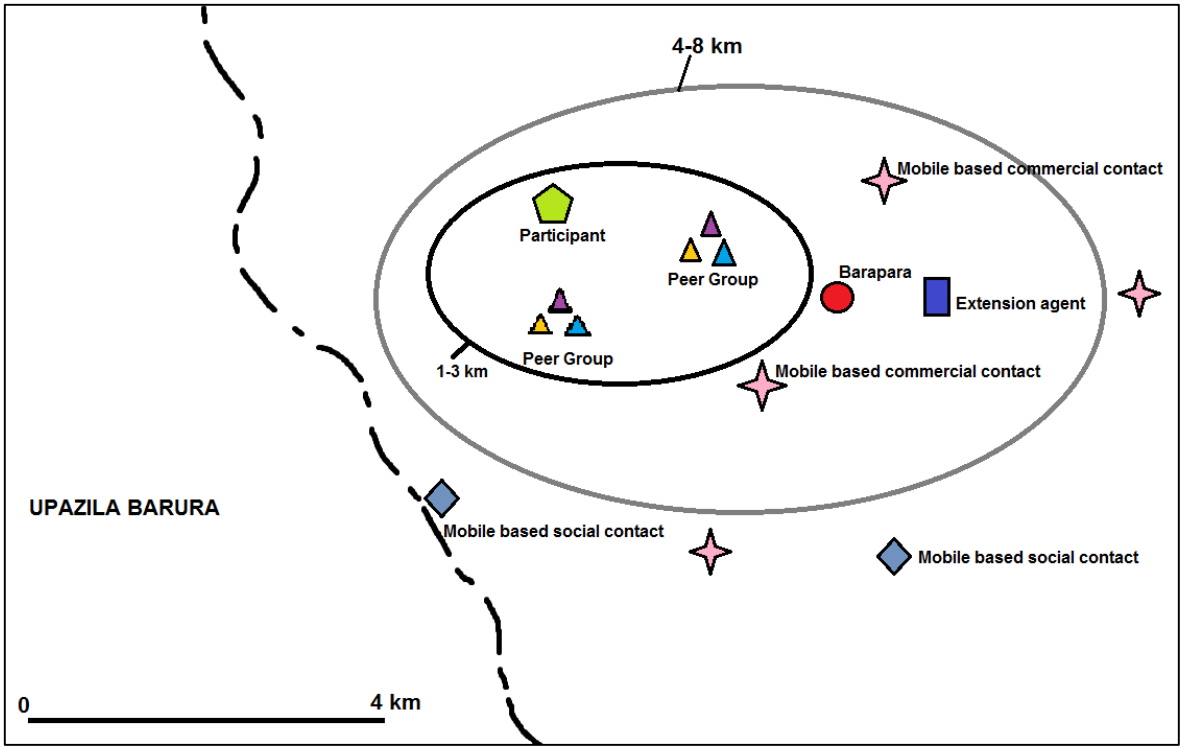
There were 54% of calls for commercial communication (incoming and outgoing calls) compared to 44% of calls for social communication during the harvesting season. According to the participant, along with communication with social contacts such as extended family and friends, there is regular communication with immediate family members. The participant's immediate family members also own mobile phones, which allows the participant to communicate with his wife and children when he is out in the field. Therefore, the social communication is for friends, family and immediate family interactions. On the other hand, in terms of commercial communication, the participant received eight commercial calls during these ten days. According to the participants, there were calls from the government extension agent about the group meetings organized by the government agricultural ministry to train farmers.

The communication pattern during the three phases differs significantly for the participant. During the harvesting phase and post harvesting stage, the calls per day were on average between eight to ten. These calls consist of the commercial contacts from different markets. However, the participant had one full season with no crop production, and he worked for other farmers during this time. Phone calls during the lean season dropped to one to two per day. During the land preparation phase, the calls per day remained between four and five.

Social Network Analysis

The participant communicates with the family, extended family with a mobile phone. There are overlap contacts, such as son-in-law, brother-in-law and father of the participant who is involved in the farming profession. The communication with them is vital for the participant from both commercial and social perspectives. The participant has frequent social contact with her daughter and extended family, which is not commercial in nature, but 'close-tie' social connectivity. The participant also communicates with the commercial contacts, which are essential but not considered as close-tie contacts such as agricultural service over mobile phone.

The third participant lives in Barapara, Comilla. The participants' family members, some social and commercial contacts live within one to three kilometers. According to the network map, the participant has social and commercial contacts within four to eight kilometers and contacts beyond eight kilometers. The participant communicates face to face with the contacts who live within one to three kilometers and uses his mobile phones to communicate with all other contacts beyond three kilometers. The primary commercial contacts are the wholesaler and beparies who live near Barapara approximately four to seven kilometres from the participant respectively. The government extension agent resides approximately six kilometres away and the regular communication medium for these contacts is the mobile phone.



Nature of Network

The third participant has a total of 140 contacts on his phone. A total of thirty-seven of these contacts are commercial in nature. The social contacts consist of the family, extended family, and friends who live in distant locations. The participant started to use a mobile phone from the year 2004. According to the participant, he uses the mobile phone to communicate with government extension agents for any farming related suggestions. The regular communication with the government officials also allows the participant to keep updated on the government subsidies, new seeds and other related news. There are three overlap contacts, two friends who do farming on the neighbouring land and his brother-in-law who is also in rice production.

In terms of 'centrality' the participant close-tie contacts (social, commercial or socio-commercial) have a one to one relationship with the participant. There are commercial contacts with whom the participant regularly communicates; these commercial networks are the buyers themselves. Therefore, the participant has the access to information directly from the local buyers. There are not too many weak ties in the participant's network, other than the call centre-which the participant tends to use frequently. Therefore, the participant does not have other options for new information other than the call-centre.

Based the network map the participant has dyadic and multiplex relations with close-tie social contacts, which with the participant share social and commercial dialogue. Among these contacts there is the brother-in-law and son-in-law who share both commercial and social discussions. There are social contacts, who are dyadic in nature, but not multiplex, since the communication between the contacts is social only, such as the participant's communication with her daughter. From a commercial point of view, there are non-dyadic commercial contacts such as distant buyers, suppliers with whom the participant does not have frequent communication, but a contact when needed. There are also commercial contacts who are non-dyadic with whom the participant communicates more frequently such as the call-centre. There are also dyadic commercial contacts, such as the local arothdar who is the regular buyer for the participant; also, the close-tie commercial contact for the participant. However, there is no social connection with the dyad commercial contact, therefore does not constitute a multiplex network.

Agency

The participant finds that the information received through the use of the mobile phone is relevant. The participant believes the relevant information becomes available because with mobile phone it is easy to communicate with the appropriate contacts for information. Similarly, the participant always finds that the information obtained through using the mobile phone is 'important' because the mobile is always is at his disposal in the time of crisis. The desired information is always accessible through the social and commercial networks created by the participant. The participant has two types of influences of social capital: 'structural' and 'cognitive' (Chritiaan, and Thierry 2001). It is structural when the information is accessed through the network created by the participant, and it is cognitive because the participant trusts the information is relevant and timely.

Structure

The participant's commercial contacts are not concentrated in any particular location. One of the major buyers for the participant is a wholesaler from alma bazar (referred to in the mobility map), which is a distant market. According to the participant, communicating with both social and commercial contacts helped him to find individuals who became commercially beneficial contacts. Therefore, the particular wholesaler referred that was referred earlier is commercially connected with the local suppliers. As the participant described, his produce does not have any transportation cost because the local suppliers take his goods as pre-arranged by the wholesaler from Alma bazar.

According to the participant, frequent communication with the government extension agent also is immensely beneficial. The department of agricultural extension provides various subsidies and support for the farmers. The extension agent, as a local government representative, plays a vital role in the process of farmer selection for the services provided by the government. As the participant is a close-tie network to the extension officer, it benefits the participant to be able gain access to such government benefits.

Choice

The use of mobile telephony by the participant is between eight to ten calls during the harvesting season. The mobile usage during the lean season drops to two to three calls per day. According to the participant, the use of mobile telephony in the harvesting season increases due to communication with the wholesaler and the other buyers. This process of communicating with the other buyers provides the participant with a bargaining power on the price of the produce (ref). The mobile telephony is the 'existence of choice' for the participant. The participant believes that communicating with various other buyers to gain the accurate price of the produce is the 'sense of choice.' As the participant uses his knowledge on the price to negotiate with the buyer, this is the 'use of choice' for the participant.

Costs associated with the mobile phone and financial benefits

According to the participant, the transportation was organized through information communication with the wholesaler. In the harvesting season, it takes the participant not more than six to seven calls to make the arrangements, which costs a total of 50 to 60 taka (GBP 4-5). According to the participant, this saves him at least 2,000-3,000 taka (GBP 230-260). During the harvesting time, the participant communicates with the other buyers to confirm the price, which also benefits the farmers by saving 10 taka per kg of production.

Case Study Four

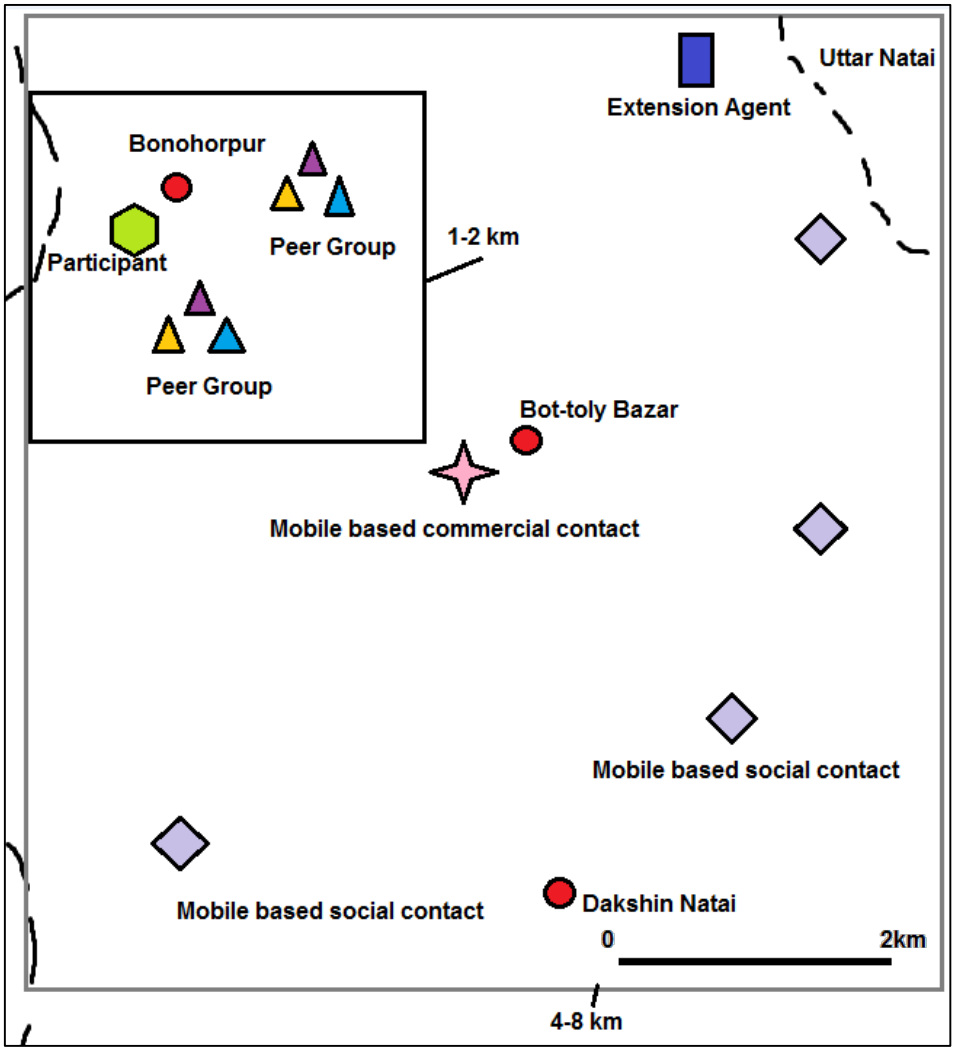
Name: *Mrs. Mita*
Location: *Bonohorpur, B Baria*
Age: *38*
Education: Level *5*

Background

Mrs. Mita Babu has lived in Bonohorpur since marriage, which was approximately twenty-four years ago. She lives with her husband and three daughters. The participant's husband works with the local police and she works as a farmer and owns 1.5 acres of land. The land she owns is considered high-land, which allows her to grow rice for three seasons: Aush, Aman and Boro.

Network mobility map

The fourth participant in Comilla lives within the two kilometers of Bonohorpur market. Her immediate family and associates live within one to two kilometers of that area. The participant communicates with extension agent who lives close to Uttar Natai region, and Bonohorpur is within the catchment area of the government extension agent. The other most communicated commercial contact of the participant lives in the Bot-toly Bazar area. There are also important commercial contacts of the participant lives near the Dakshin Natai area, which is within five to eight kilometers from the participant.



Nature of Network

The forth participant has a total of eighty-seven contacts on her phone. There are thirty-five commercial contacts and fifty-two social contacts. Among the commercial contacts, there are eleven overlaps. These overlaps are mainly immediate and extended family members, such as sons-in-law, cousin, brother-in-law and uncle. The participant has been using the mobile phone since 2006.

Communication with social and commercial contacts

The participant has a total of eighty-seven contacts on her phone. There are thirty-five commercial contacts and fifty-two social contacts. Among the commercial contacts, there are eleven overlaps. These overlaps are mainly immediate and extended family members, such as sons-in law, cousins, brothers-in law and uncles. The participant has been using the mobile phone since 2006.

Network and communication

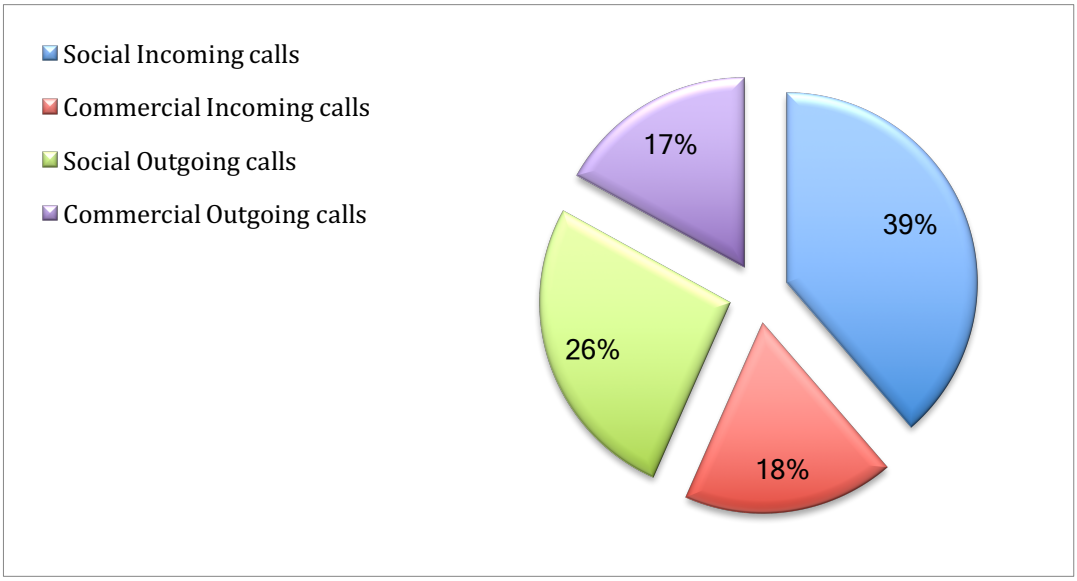
Mrs. Mita considers the mobile phone as the most important element of her rice production. The participant believes that it is important because it allows her to communicate with the 'right' people that are relevant to her business. The participant explained that the rice production requires a lot of communication and networking with the people who work in the rice production supply chain. According to the participant, the commercial contacts that are necessary for trade include seed suppliers, fertilizer suppliers, extension agents, wholesalers, transport and market informers.

> "Mobile phone allows me to connect with the right people in the trade"
>
> - Mita

The participant believes that the level of trust is vital for the trade. In her experience, she trusts the village traders and wholesalers more than the 'city buyers'. The participant's commercial contacts consist of the people from different local markets, whom the participant trusts in terms of produce prices.

The participant also has access to media such as radio and television. According to the participant, there are particular radio and television programs that are useful for her trade. According to the participant, the mobile phone is more capable of delivering new ideas than the TV or radio. The participant uses an agricultural tele-service provided by AIS and MPower (discussed earlier), which provides information about any agriculture related queries. The participant makes one to two calls per day on average. According to the participant, there are both commercial and social contacts. The calls per day vary during the harvesting season, land preparation and lean season. Phone data has been collected for the lean season, which was June 2013 (pre-Aush harvesting period) and for the harvesting season (July 2013 during the Aush harvesting season). During the pre-harvesting period, there were sixty incoming calls and forty-six outgoing calls. Among these incoming calls, there are forty-one social calls and nineteen commercial calls. Among the outgoing calls, there were twenty-eight social calls and eighteen commercial calls. There were a total of ten incoming calls from overlaps and eight outgoing calls to the overlapping contacts.

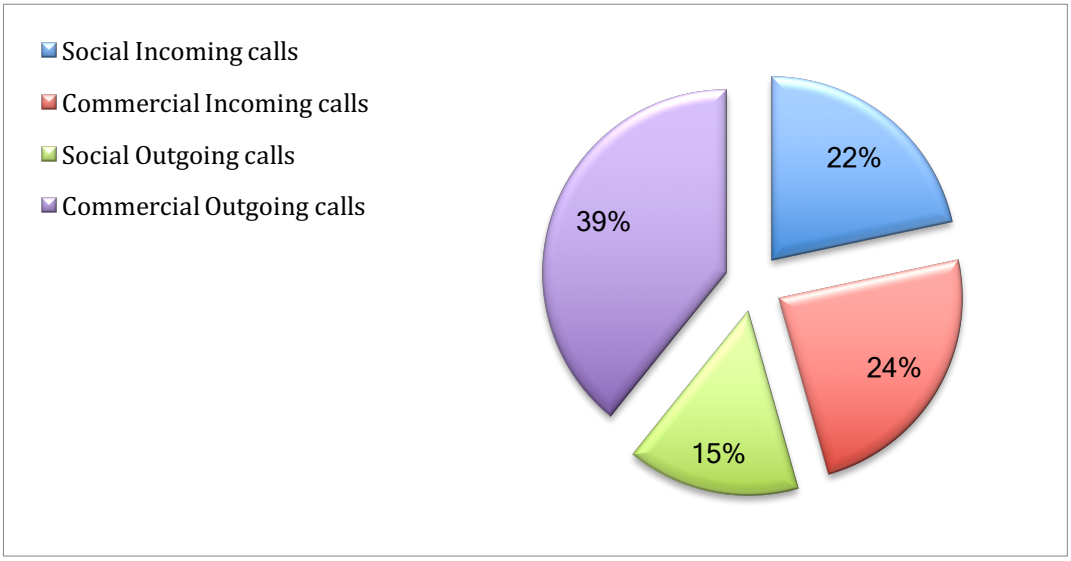
Mobile-based communication during lean season



There are 65% of social communication calls, compared to the 35% for commercial calls. According to the participants, the social calls consist of friends and immediate family. The commercial communication includes communication with support workers and extension agents.

During the harvesting season (July 2013), there were a total of seventy-eight incoming calls and ninety-three outgoing calls. Among the incoming calls, there were a total of forty-one commercial calls and thirty-seven social calls. Among the outgoing calls, sixty-seven were commercial calls and twenty-six were social calls.

Mobile-based communication during harvesting season



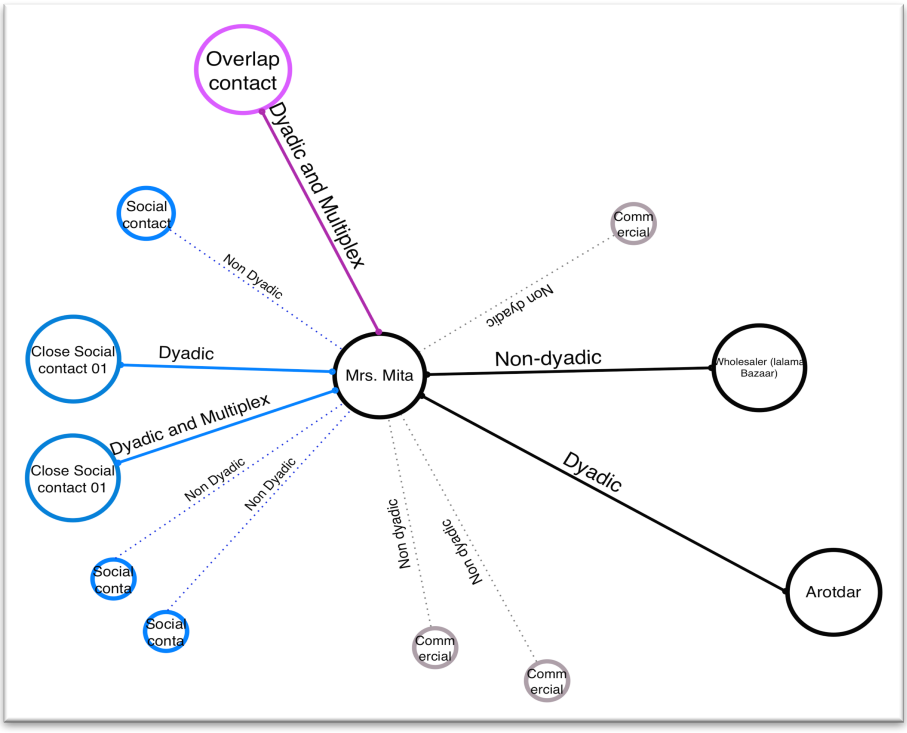
There is a total 63% commercial communication compared to 37% for social communication.

Social Network Analysis (SNA)

The participant communicates with the family and extended family with a mobile phone. There are overlapping contacts, such as a son in law, brother in law and father of the participant, who is involved in the farming profession. Communication with them is vital for the participant from both commercial and social perspectives. The participant has social contacts, such as frequent contact with her daughter and extended family, which is not commercial in nature but is a close-tie social connectivity. The participant also communicates with the commercial contacts that are essential but not considered close-tie contacts, which includes agricultural service over the mobile phone.

In terms of 'centrality', the participant's close-tie contacts (social, commercial or socio-commercial) have a one-on-one relationship with the participant. There are commercial contacts with whom the participant regularly communicates; these commercial networks are the buyers themselves. Therefore, the participant has access to information directly from the local buyers. There are not too many weak ties in the participant's network, other than the call centre-which the participant tends to use frequently. Therefore, the participant does not have other options for new information other than the call centre.

SNA Map



Based the network map, the participant has a dyadic and multiplex relation with close-tie social contacts, which share social and commercial dialogue with the participant. Among these contacts, there is a brother-in-law and a son-in-law who he has both commercial and social discussions with. There are social contacts, which are dyadic in nature but not multiplex, since the communication between the contacts is social only, such as the participant's communication with her daughter. From a commercial point of view, there are non-dyadic commercial contacts such as distant buyers and suppliers with whom does not frequently communicate, only when needed .There are also commercial contacts that are non-dyadic such as call centres, although the participant communicates more frequently with that call centres... There are also dyadic commercial contacts, such as the local arothdars, who are regular buyers for the participant, and the close-tie commercial contacts. However, there is no social connection with the dyad commercial contact, therefore the network is not a multiplexity.

Agency

The participant believes that the information she receives from the buyers is trustworthy. According to the participant, the contacts have been chosen because they provide information relevant to her trade. For example, her communication with the agro call service provides information about farming technology. According to the participant, because the mobile phone allows her to communicate whenever the need arises, the participant finds the use of the mobile phone very relevant.
Structure - government agencies, groups formed by buyers or sellers, peer-groups

The participant uses mobile telephony to access information from government extension agents and AIS- a government call centre for agricultural-related queries. The participant also seeks advice and support from family members who are involved in farming. The participant communicates with government and call centres to gather information about rice technology, so the information creation for the participant is directly impacted by the mobile based-contacts that she created. On the other hand, the participant communicates with male family members to help her in the field, which created a peer group for the participant to receive support during the harvesting and land preparation seasons. These arrangements created a structure for the participant to receive support in the her rice production.
Choice

According to the participant, the use of the mobile phone enabled her to be able to communicate with people she usually had no other way to communicate with. Having a mobile phone allowed her to communicate with the contact, which can be referred to as the existence of choice for the participant. Thereafter, utilizing the phone to call

contacts such as the extension agent to receive information is a sense of choice. The participant generally communicates the information needs with the extension agent or the call centre and receives information that she utilizes in her field – this is the use of choice for the participant.
Costs associated with the mobile phone and financial benefits

The participant spend on average eight hundred to nine hundred taka (GBP 8-9) on mobile phones every year. During the harvesting season of July 2013, the participant spent one hundred and forty taka on mobile phones. According to the participant, she uses the mobile phone to contact the support worker and transporter using. These calls costs her on an average of 8-10 taka. The participant has no landline connection in the house, and because of the children in the house, the participant cannot commute to contact these individuals other than with the mobile phone. Therefore, from a financial point of view, the participant believes that there is a certain financial benefit to be able to communicate and get assistance from these people in the field.

Case study five

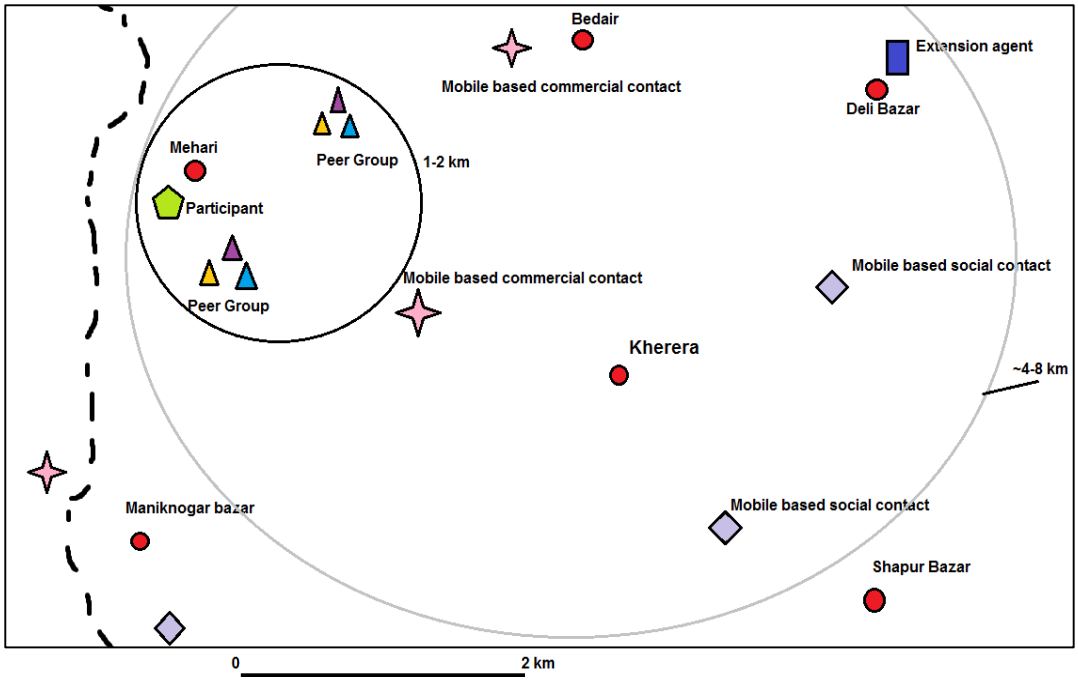
Name: *Mr. Hasan*
Location: Mahari, Kashba
Age: *46*
Education: Level *8*

Background

Mr. Hasan lives in Mahari, a place within two kilometres of Jamuna Bazzar. He lives with his wife and four children. The participant has been living in the area since birth. The participant owns two acres of land where he grows rice in three seasons, Aush, Aman and Boro. He has been using the mobile phone since 2007.
Network mobility map

For the fifth participant, the extended family and friends live within one to three kilometers of the location, Mehari, in Comilla. According to the network map, the

participant's mobile based commercial contacts live in the Kherera area, Deli Bazaar – that are within three to eight kilometers distance. There are contacts in Manik Nagar Bazaar and Shapur Bazaar, which are approximately within ten kilometers from the participant. The government extension agent lives near the Deli Bazaar.



Nature of Network

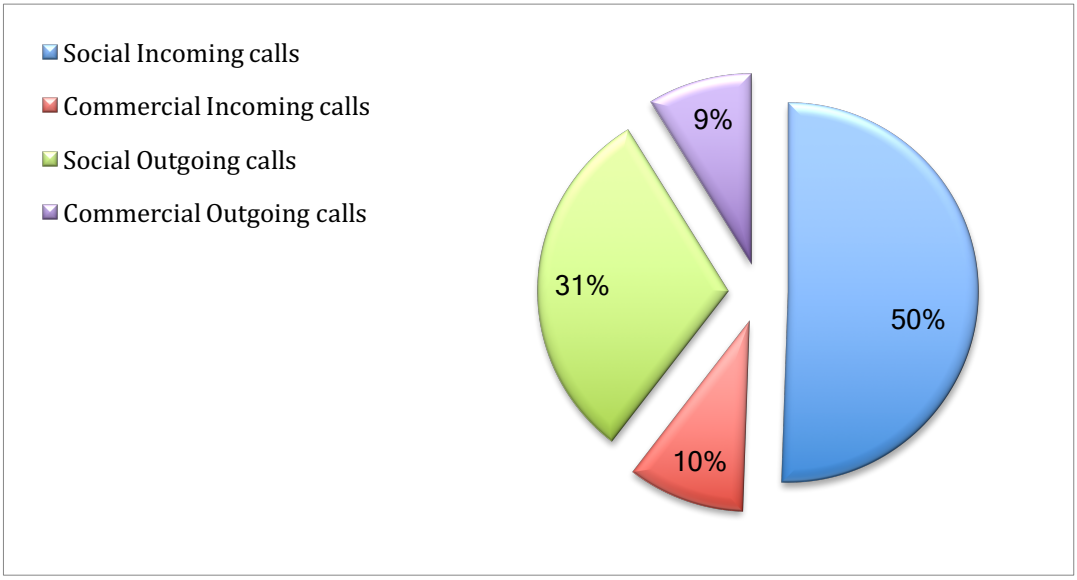
The fifth participant has a total of fifty-six contacts on his phone. There are forty-six social contacts and eight commercial contacts on the phone. Among the social connections, participant's eldest son lives abroad and communicates regularly. There are also extended family members in the contact list. Among the commercial contacts, there are commercial contacts who are the participant's primary seed, fertilizer supplier, distant buyers and an extension agent.

Communication with social and commercial contacts

The participant has a total of fifty-six contacts on his phone. There are forty-six social contacts and eight commercial contacts on the phone. Among the social contacts, the participant's eldest son lives abroad, who he contacts on a regular basis. There are also extended family members on the contact list. Among the commercial contacts, there are commercial contacts who are the participant's primary seed and fertilizer suppliers, distant buyers and extension agents.
Network and Communication

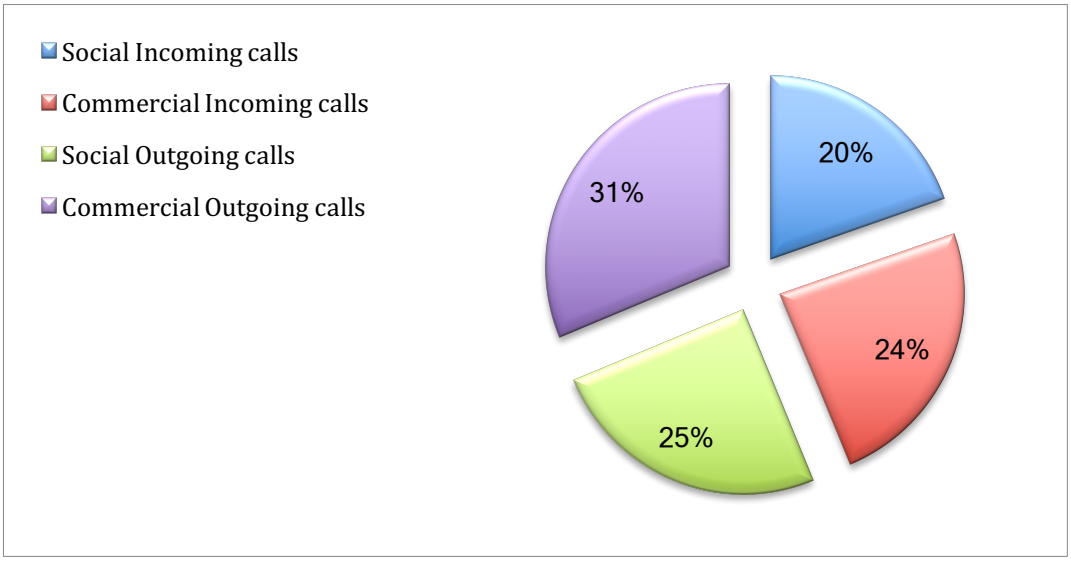
The participant finds the use of the mobile phone to be very useful to communicate and connect with distant family members. According to the participant, the communication with his son who lives abroad is the key benefit of owning a mobile phone. The participant also sees a benefit of communicating with commercial contacts that operate in distant markets. The participant does not trust information from 'little known' commercial contacts. As explained by the participant, there are commercial contacts that are connected through direct commercial contacts. The participant does not rely on the price quoted by these extended commercial contacts; however, once the price is confirmed by the immediate commercial contacts, the participant has confidence in trade relations with these extended commercial contacts.

The participant uses the mobile phone an average three to four times in a week. According to the participant, the communication does not vary much during the land preparation, lean and harvesting seasons. Mobile phone data has been collected for the lean season (June 2013) and harvesting season (July 2013 for Aush). During the lean period, there were a total of thirty-six outgoing calls and fifty-five incoming calls. Among the outgoing calls, there were twenty-eight social calls and eight commercial calls. For the incoming calls, there were forty-six social calls and nine commercial calls. Mobile-based communication during the lean season



There were 81% of calls for social communication during the lean period, compared to 19% of commercial calls. The participant explained that the social interactions are high because of calls received from abroad from his son and contacts with extended family during the lean period. The commercial calls, according to the participant, are mainly used to communicate with the two workers who help the participant on the field during the lean season.

During the harvesting season, there were a total of sixty-three outgoing calls and forty-nine incoming calls. Among the outgoing calls, there were thirty-five commercial calls and twenty-eight social calls. Within the incoming calls, there were twenty-seven commercial calls and twenty-two social calls.
Mobile-based communication during harvesting season



There was a total 55% of calls for commercial communication (incoming and outgoing calls) compared to 45% of calls for social communication during the harvesting season. The participant explained that during the harvesting season, the communication with the transporter, buyer and wholesaler increases, but there is also a commercial communication with the family and extended family during that time.
Social Network Analysis (SNA)

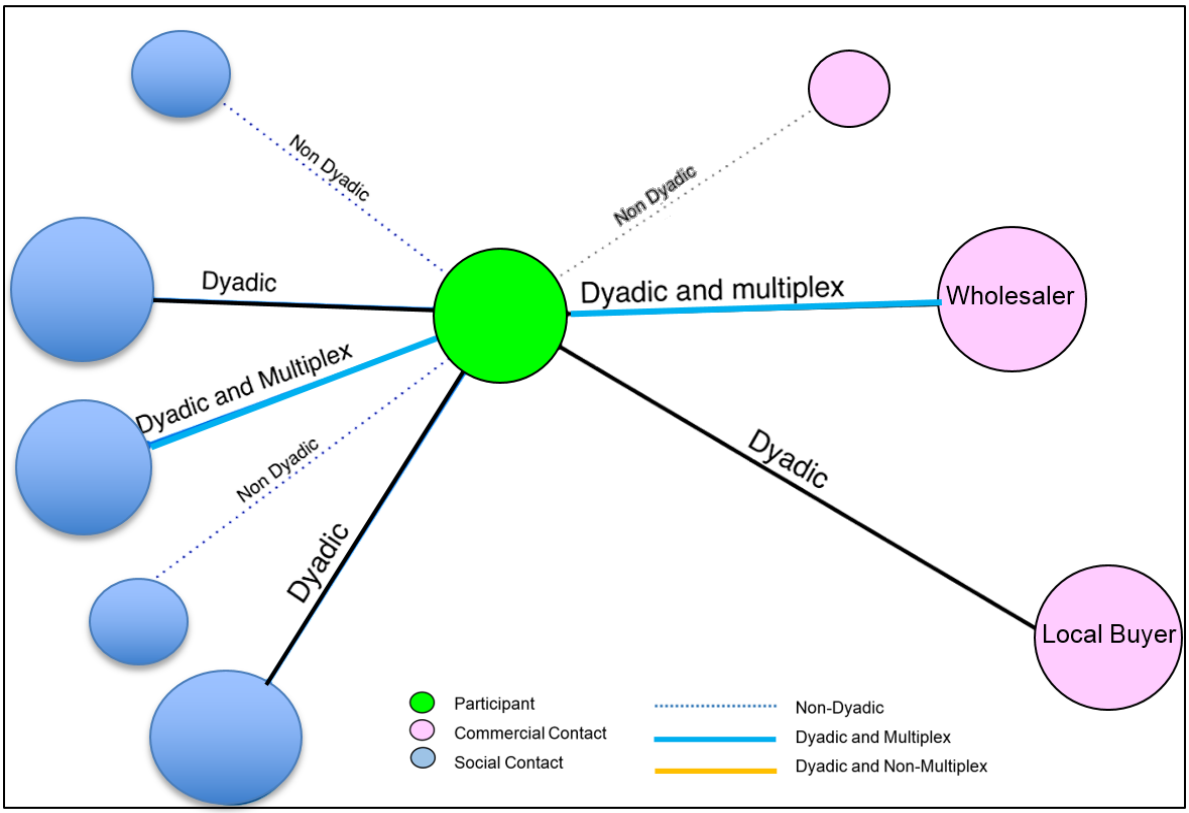
The participant has a mostly strong-tie social network, as the participant created some social and commercial contacts that he regularly communicates with using the mobile phone. The strong-tie social contacts include family members and friends. The participant created some trusted commercial contacts and preferred to do most of his agro-based trading with these contacts. There is very little existence of weak ties in the participant's network.

Case five

The participant has a strong-tie social network mostly, as the participant created some social and commercial contacts, with whom he regularly communicates using the mobile phone. The strong-tie social contacts include family members and friends. The participant does not develop new commercial contacts. Instead, he created some

trusted commercial contacts and preferred to do most of his agro-based trading with these contact. There is a very little existence of weak ties in the participant's network. In terms of commercial communication, the participant prefers the local customers and suppliers. On the occasion when the participant uses distant buyers, the communication happens directly between the buyer and the participant; therefore, the centrality of the network shows a direct communication between the nodes of the network. The network of the participant does not have a wide range of contacts. There are social contacts, with whom the participant regularly communicates for social purposes. On the commercial aspects, there are contacts who are strictly related to the participant's rice production business such as buyers and suppliers. The participant does not have connections with market informants, or with extension agents and call-centres.

SNA Map



Based on the SNA MAP, there is a dyadic commercial contact who is close to the participant from a distant market. There are similar contacts in Shapur bazar, with

whom the participant keeps a regular contact, but the nature of communication is mainly commercial. There is another type of commercial contact such as a contact with his local market wholesaler, with whom the participant has both social and commercial communication. The participant has a dyadic relation with his son, who lives abroad.

Agency

In the previous section, the network analysis shows that the participant has a selected group of people; both commercial and social contacts. These close group networks created by the participant are believed to be trustworthy. The participant believes that the mobile phone reinforces the relationship that he already has with the social and commercial contacts. This belief further encouraged the participant to utilize mobile telephony to communicate with the social contacts more often. The commercial contacts that the participant created also follow the similar pattern of communication, where the participant utilizes the mobile phone to keep regular contact with the existing commercial contacts.
Structure - government agencies, groups formed by buyers or sellers, peer-group

The participant believes that the social commercial network created a support structure for the participant. For the participant, this network that has both social and commercial contacts to gain information. Particularly from a commercial network perspective, despite having the freedom to be able to communicate with more commercial individuals, the participant communicates with the selected commercial contacts for his commercial information needs. As discussed in the previous section, the participant justifies his own preference to keep a limited number of commercial contacts as the peer group that he trusts. This limited number of people in-turn created a particular commercial support structure.
Choice

According to the participant, the mobile phone allows him to communicate with the selected social and commercial contacts. Although limited, this access to the contacts is the existence of choice for the participant. The participant trusts the contacts for commercial information and believes to have the access to information that he requires; this is believed to be the sense of choice for the participant. By practice, the participant has been relying on the commercial contacts that he created. The participant trusts the information received through these contacts and utilizes the knowledge to his benefit, and the utilization is the use of choice for the participant.
Costs associated with the mobile phone and the financial benefits

The participant spent nine hundred to one thousand taka (GBP 8-10) every two to three years. The participant spent an average of one hundred to one hundred and twenty taka. During the harvesting season, the participant spent 100-120 taka (GBP 1-1.2).The participant utilized the calls to conduct and complete the sales of produce. According to the participant, the information received by the commercial contacts, particularly in time of crisis, is the biggest financial advantage. Based on the participant's example during an Aman season in 2012, the participant's rice production was affected by a disease outbreak. The information from the extension agent regarding the pesticide saved him approximately 30,000-40,000 taka (GBP 300-350). This information and arrangement with the pesticide supplier was conducted using the mobile phone. The total cost of the calls were somewhere between 30-40 taka (GBP 3-4).

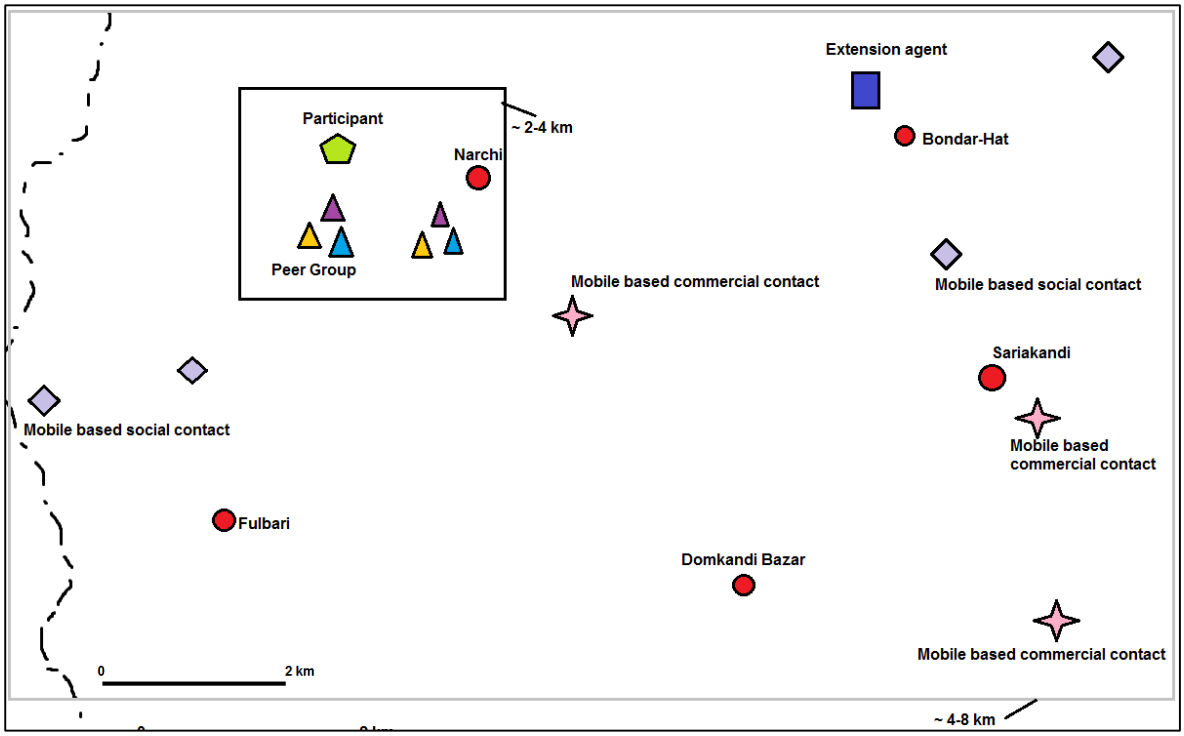
Case Study Six

Name: *Mr. Rajjak*
Location: Narchi, Shariakandi
Age: *35*
Education: Level *6*

Background

Mr. Razzak has lived in Narchi for last twenty years with his wife and three children. The participant owns two acres of land. He was originally from a nearby village and came to live with his parents, as this area is closer to his maternal family. The participants grow rice in three seasons, and he also works as a co-ordinator for the farmer's club in the village.
Network mobility map

The sixth participant lives in Narchi, in the district of Rajshahi. The extended family and friends live within one to three kilometers of the location. According to the network map, the participant's mobile based commercial contacts live in the Narchi area, – that are within three to eight kilometers distance. There are contacts proximal to Sariakandi, which is approximately within ten kilometers from the participant. The government extension agent lives near the Bondar-Hat.



Nature of Network

The sixth participant has a total of one hundred and forty-three contacts in his mobile phone. Among these contacts, there are forty-eight commercial contacts and eighty-three social contacts. Among the social contacts is his father, who is also a farmer in the neighbouring land, his younger brother and extended family members, the imam of the mosque. Among the commercial contacts, there are the local buyer, supplier, arothdars and city-sellers.
Network and Communication

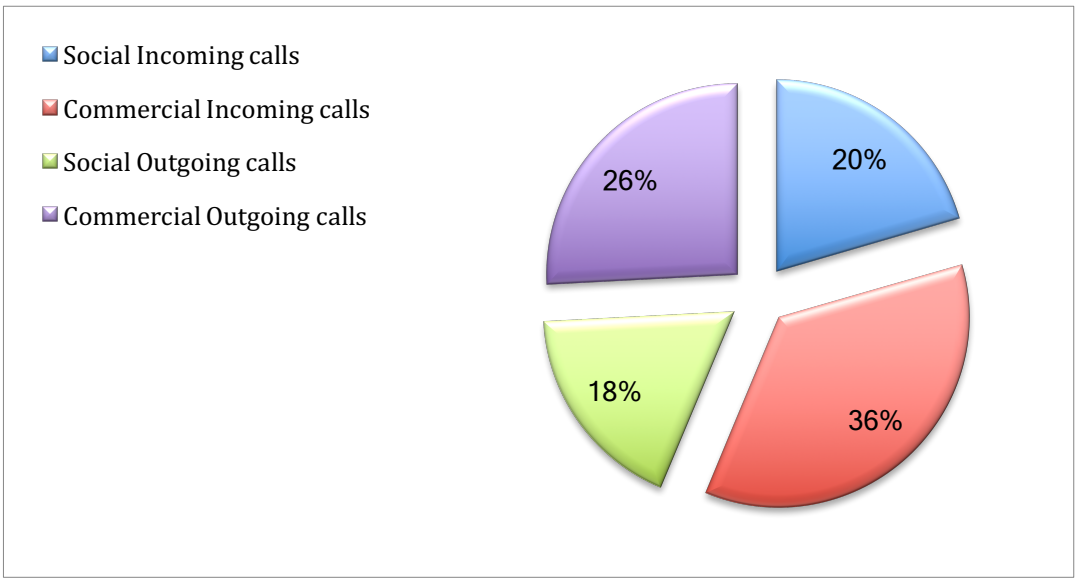
The participant believes that the mobile phone is useful because it allows others to communicate with him instantly wherever he is. According to the participant, the ubiquitous nature of the mobile phone benefits him because he is easily reachable by his social and commercial acquaintances. The social communication includes communication with the immediate and extended family members. There is communication with the other farmers to organize meetings, events and arrange social gatherings. The participant also communicates with imam of the mosque and the government extension agent.

> "Mobile allows others to contact me instantly, wherever I am."
>
> - Razzak

According to the participant, he uses the mobile phone four to five times a week. According to the participant, the mobile phone usage during different seasons of land preparation, lean and harvesting does not vary much. Mobile data on the lean season

(June 2013) and harvesting season (July 2013) has been collected for a better comparison. During the lean season, there were eighty-five incoming calls and sixty-seven outgoing calls. Among the incoming calls, there were thirty-one social calls and fifty-four commercial calls. Within the outgoing calls, there were thirty-nine commercial calls and twenty-seven social calls.

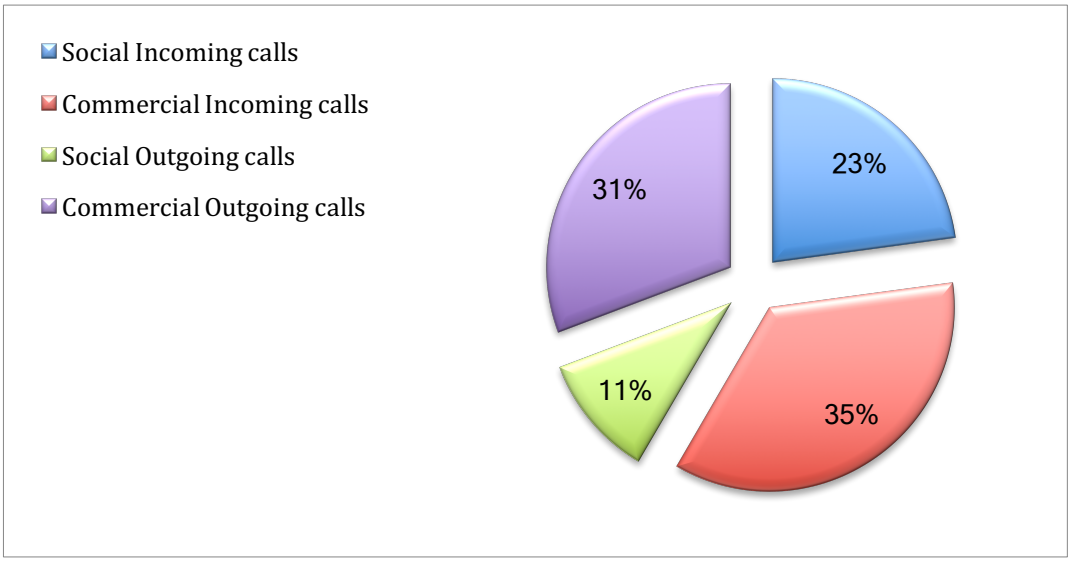
Mobile-based communication during lean season



There were 62% of calls for commercial communication and 38% of calls for social communication. According to the participant, the majority of the commercial communication was regarding organizing the farmer's club, which mostly consists of the other farmers. There are social interactions with family and friends.

During the harvesting season, there were one hundred and fifty-six incoming calls and hundred and eleven outgoing calls. Among the incoming calls, there were ninety-five commercial calls and sixty-one social calls. Among the outgoing calls, there were eighty-two commercial calls and twenty-nine social calls.

Mobile-based communication during the harvesting season



There was a total 66% of calls for commercial communication (incoming and outgoing calls) and 34% of calls for social communication. The participant explained that the commercial communication increases when communicating with contacts such as buyers, city sellers and arothdars. For the social communication aspects, there is generally social interaction with the immediate and extended family members.

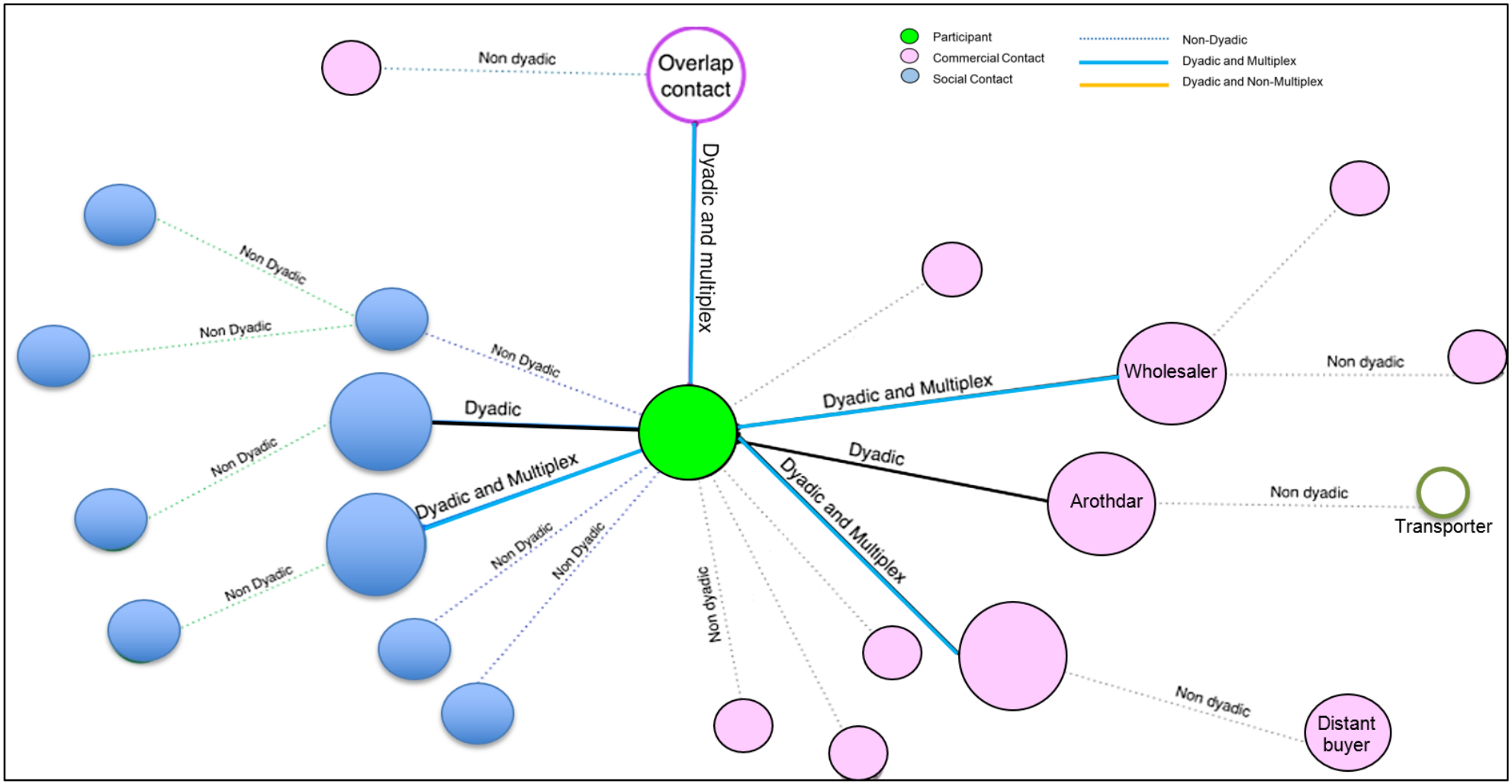
Social Network Analysis (SNA)

The participant has many social and commercial contacts. There are both strong ties and weak ties in participant's contact list. Among the strong ties, the participant has both social, commercial and socio-commercial contacts. As the president of the farmer's club, the participant also created weak-tie commercial contact, which benefit the participant by providing access to new information.
The participant has a range of social and commercial contacts. There is heterogeneity in the number of commercial contacts the participant created. There are farmers in the participant's contact list who are involved in the other types of farming. The extension agent and local mosque imam are also examples of the heterogeneity in the participant's network.

The participant has many social and commercial contacts. There are both strong ties and weak ties in the participant's contact list. Among the strong ties, the participant has both social, commercial and socio-commercial contacts. As a president of the farmer's club, the participant also created weak-tie commercial contacts that benefit

the participant by giving access to new information from these sources. The participant has a range of social and commercial contacts. There is heterogeneity in the number of commercial contacts the participant created. There are farmers in the participant's contact list who are involved in the other types of farming. The extension agent and local mosque imam is also an example of the heterogeneity in the participant's network. There are commercial contacts, according to the participant who is being introduced by the dyad commercial contacts. These contacts are also being communicated with in times of trade necessity. The participant communicates with these contacts for selling produce and using transport. These are the structural-hole that provides commercial benefit to the participant.

SNA Map


Participant
Commercial Contact
Social Contact
Non-Dyadic
Dyadic and Multiplex
Dyadic and Non-Multiplex
Overlap contact
Non dyadic
Dyadic and multiplex
Non Dyadic
Non Dyadic
Non Dyadic
Dyadic
Non Dyadic
Dyadic and Multiplex
Non Dyadic
Non Dyadic
Non dyadic
Dyadic and Multiplex
Dyadic and Multiplex
Wholesaler
Non dyadic
Dyadic
Arothdar
Non dyadic
Transporter
Non dyadic
Distant buyer

Based on the SNA MAP, the participant has dyadic social contacts with his family members and extended family members. There are non-dyadic social contacts, whom the participant does not communicate frequently. There are also social contacts whom the participant got connected through dyad contacts. Within these contacts, there are multiplex contacts with whom the participant talks business, such as friends who are also involved in the farmers' club. These contacts also share club-related discussions. Among the commercial contacts, there are dyad contacts with whom the participant frequently interacts for trade-related communication. Within the dyad commercial contacts, there are multiplex communications for social exchange. However, these are not similar to overlaps as overlap contacts are the contacts who share both commercial and social exchanges. These are individuals such as the brother of the participant who is a social contact but also shares business interests. Among the commercial contacts, there are commercial contacts, which are connected through dyad commercial contacts. As an example, there are farmers who are connected with the participant through the other dyad commercial contacts

Agency

The participant, being the organizer of the farmer's club, believes that communication is a crucial part of his trade and involvement with the other farmers. The participant trusts the information received through the mobile phone because the participant personally knows these people. Therefore, the trust is related to the familiarity with the individual. The participant believes that the mobile phone is capable of communicating with a number of people without physically being present in the location. Therefore, it is on many occasions superior to face-face communication.
Structure - government agencies, groups formed by buyers or sellers, peer-group

The participant utilizes the mobile phone to interact with a diverse group of people. The participant communicates with government agencies, extension agents, government scientific research officers (DAE) and union officers. These contacts provide important input for the participant's rice production. The participant, being the organizer of a farmer club, communicates with local leaders such as the imam of the mosque. Therefore, the participant created a support structure that was unique from the other participants. The participant's role as an organizer of a club influences his social and commercial communication patterns. The previous section showed how the number of commercial contacts that communicate in both the lean season and harvesting season are high due to his regular interaction with the number of farmers who are connected through the farmers' club.

Choice

According the participant, having a mobile phone allows the participant to communicate with a number of people. The participant chose the mobile phone to communicate with these people; therefore, the communication with more people became easier for him. This utilization of the mobile phone for communicating is the sense of choice for the participant. According to the participant, he prefers using the mobile phone to communicate with social and commercial contacts rather than physically traveling to communicate. This is the existence of choice, for the participant to be able to use the mobile phone to serve his interest. From the earlier SNA chapter, it was shown that the participant communicates with a number of farmers to organize the club, and this organizing by using mobile phone is the use of choice for the participant.

Costs associated with the mobile phone and the financial benefits

The participant spent an of average one thousand to twelve hundred taka (GBP 10-12) on mobile hand set in three to four years. The participant spent an average of one hundred thirty to one hundred and eighty taka (GBP 1.2-1.6) per month on the mobile phone. According to the participant, the trade communication is almost always done though using mobile phone. The participant believes that the mobile phone works not only for marketing but also as an assurance of timing and confirmation of the trade. According to the participant, being the organizer of the farmer's club allows him to receive 300 taka (GBP 2.5-3) monthly from the club. His job as an organizer is primarily to organize the weekly meetings, which cost him roughly 100-180 taka (as mentioned previously). Therefore he gains almost 100 TK (GBP .80) every month by using the mobile phone.

Case Study Seven

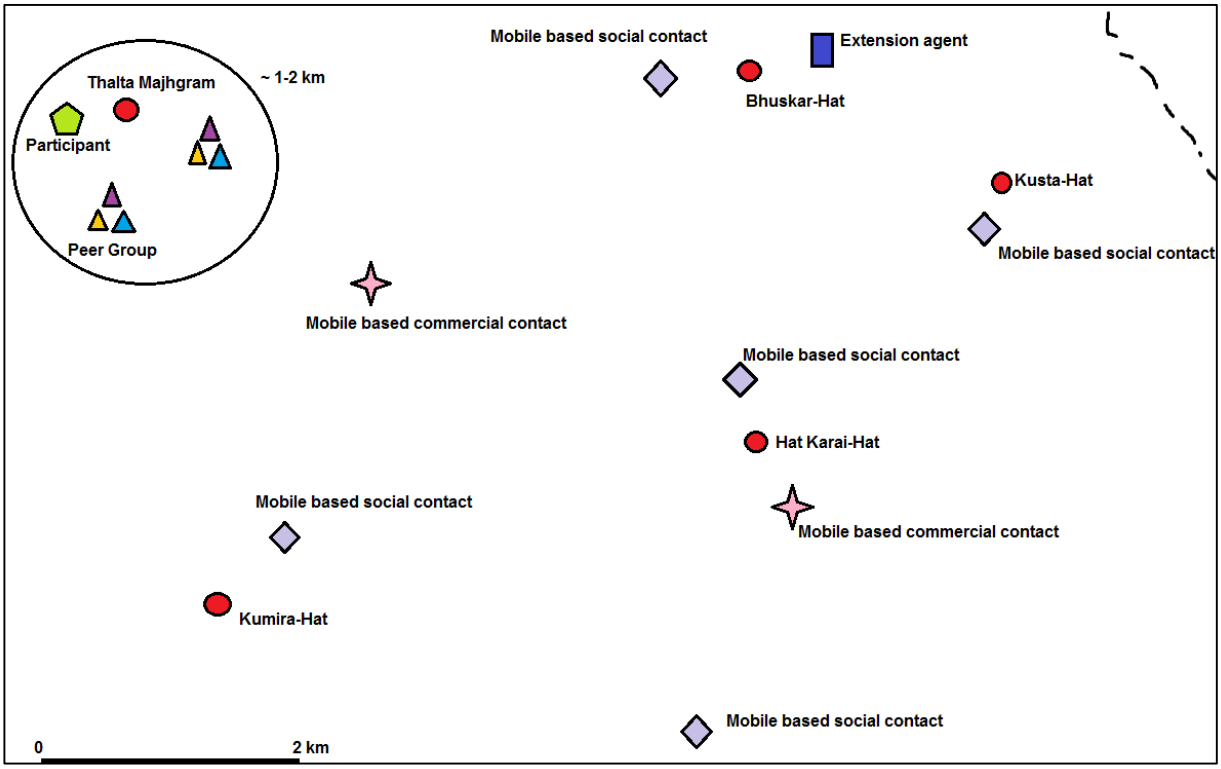
Name: *Mr. Ohab*
Location: Basho hut, Nandigram
Age: *52*
Education: Level *3*

Background

Mr. Ohab lives in the Basho hut, which is central to the Taltha Majhgram town. He has lived in this village since childhood, and he currently lives with his wife and four children. The participant owns 1.4 acres of land in the location; he also leased another one acre of land. The participant's land can produce rice in two seasons, but the leased land can produce in three seasons: Aush, Aman and Boro.

Network mobility map

The seventh participant operates in the nearest market of Thaltha Majhgram. However, he communicates with the arothdars from Bhuskar-Hat and Kusta-hat, which are within five to six kilometers from the participant's land. There is also a buyer in the Hat karar hat (at six kilometers distance) and the nearest Trimohani Hut (three kilometers) from the participants. The extension agent is based in the Thaltha Majhgram, therefore, very near to the participant's location. There are also buyers from Kumira-Hat (seven kilometers) and Kallyan Nagar (ten to fifteen kilometers) from the participant. The participant believes that the more market information one gets, the better it is for business. This motive is reflected in his network-map.



Nature of Network

The seventh participant has a total of forty-three contacts on his mobile phone. Among these contacts, there are twenty-seven commercial contacts and sixteen social numbers. The participant has a separate diary to keep all the numbers-which has one hundred and forty-one additional numbers. These numbers consist of landline and mobile numbers. Among the most frequently communicated numbers, there are commercial contacts such as seed/fertilizer suppliers, extension agents and arothdars from different locations. Among the social connections, there are extended family members, friends and neighbours with whom the participant communicates on a regular basis.

Communication with social and commercial contacts

The participant has a total of forty-three numbers on his mobile phone. Among these numbers, there are twenty-seven commercial contacts and sixteen social contacts. The participant has a separate diary to keep all the numbers, which has one hundred and forty-one additional numbers. These numbers consist of landline and mobile numbers. Among the most frequently communicated numbers, there are commercial contacts such as seed/fertilizer suppliers, extension agents and arothdars from different

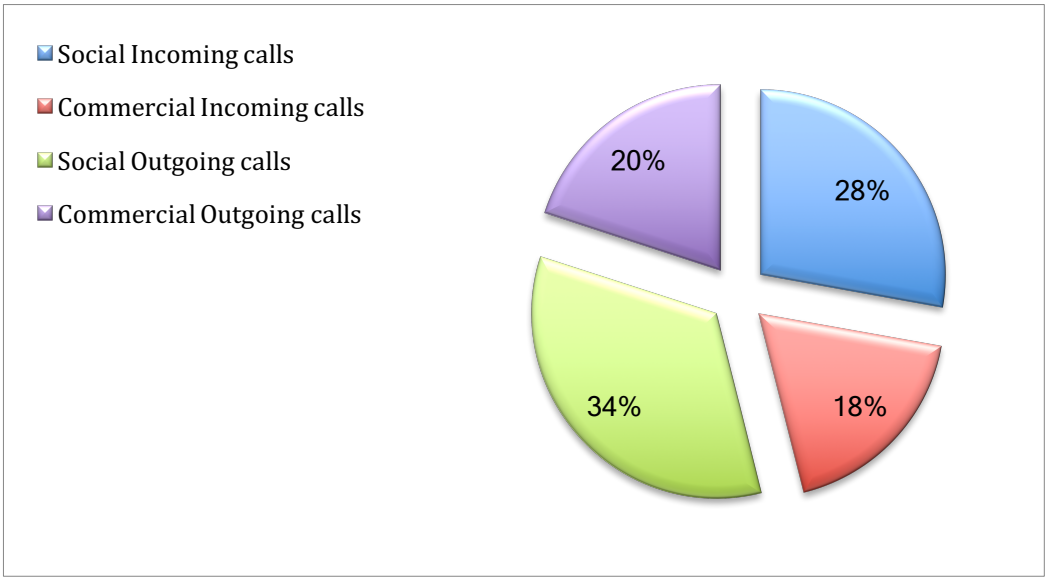
locations. Among the social contacts, there are extended family members, friends and neighbours with whom the participant communicates on a regular basis.

Network and Communication

The participant finds that the use of the mobile phone is imperative because it allows the individual to communicate with many buyers and arothdhars to negotiate the price and sell produce on time. The participant believes that selling the produce is the most important element of the business, and the mobile phone allows him to communicate and contact many buyers and wholesalers from distant markets where face to face communication is not possible. According to the participant, the social usage of the mobile phone includes communicating with friends and family about family events, emergencies and financial support in times of need.

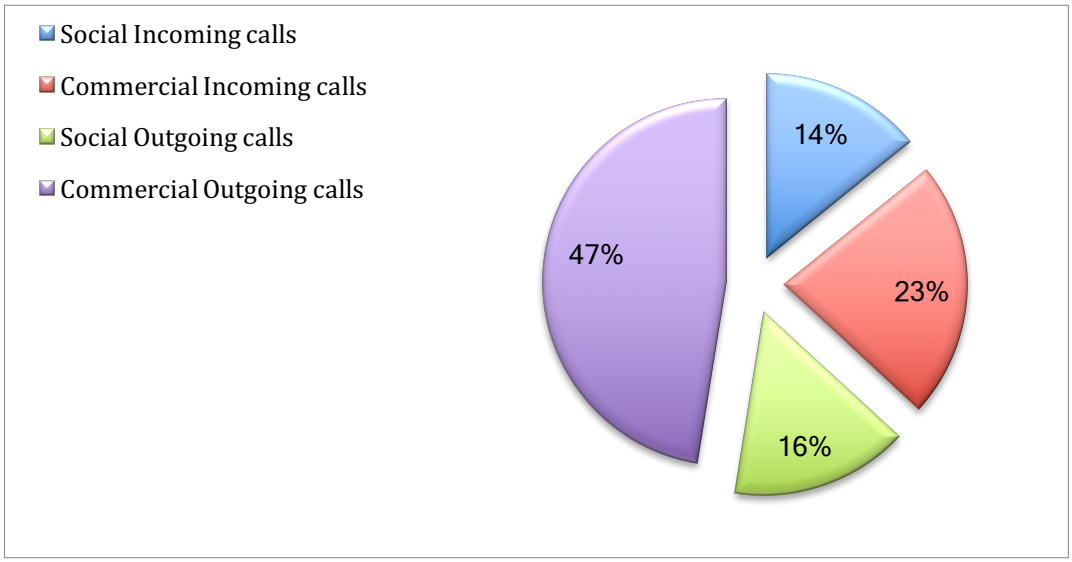
The participant uses the mobile phone an average of five to six times a week. According to the participant, communication does not vary much during the land preparation and the lean and harvesting seasons. For a batter comparison, the mobile phone's data has been gathered for the lean season (June 2013) and the harvesting season (July 2013). There were a total of sixty-eight outgoing calls and fifty-four incoming calls. Among the outgoing calls, there were thirty-nine social calls and twenty-three commercial calls. Within the incoming calls, there were thirty-two social calls and twenty-one commercial calls.

Mobile-based communication during lean season



There was a total 38% of calls for commercial communication during the lean season, compared to 62% of calls for social communication. According to the participant, the commercial communication is mostly about communicating with the other suppliers and the support workers at the field. Social communication is mostly about keeping contact with the family while the participant is at the field.

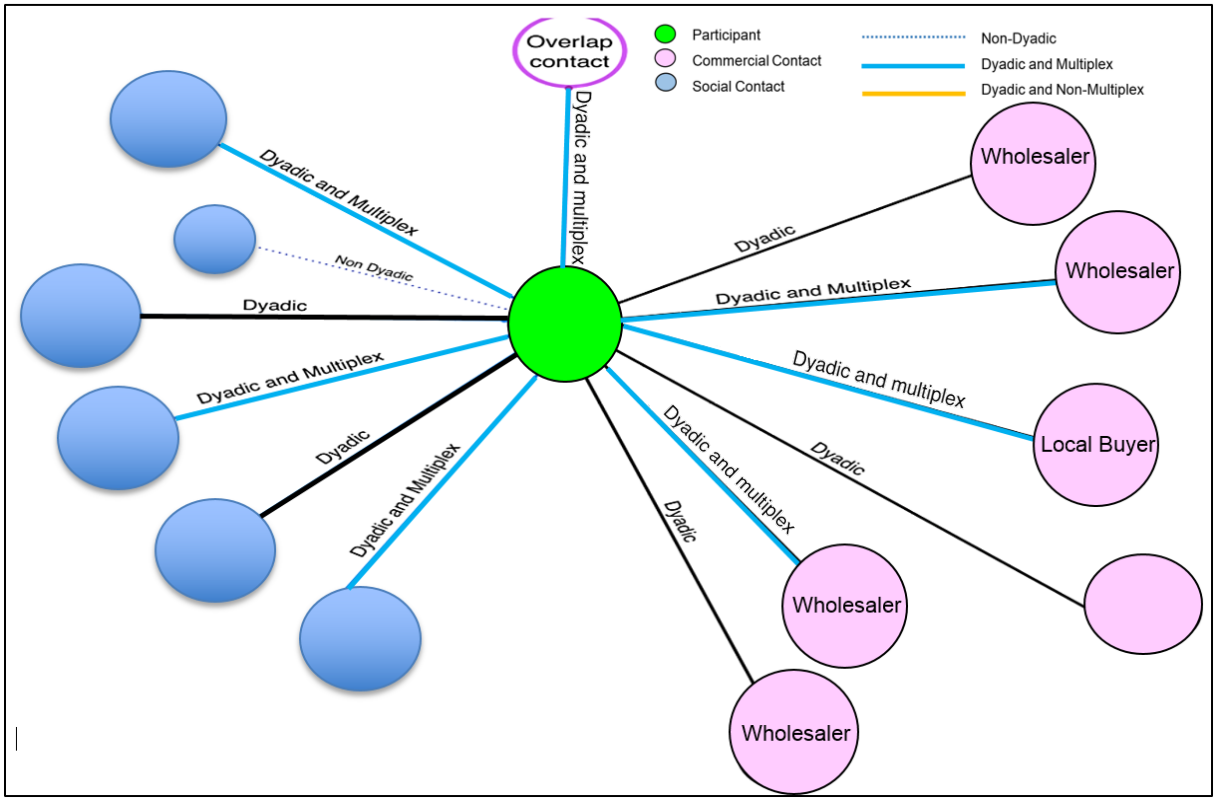
During the harvesting season, there were a total of one hundred and thirty outgoing calls and seventy-three incoming calls. Among the outgoing calls, there were a total of ninety-four commercial calls and thirty-one social calls. Within the incoming calls, there were a total of forty-five commercial calls and twenty-eight social calls.
Mobile-based communication during the harvesting season There was a total of 47% of commercial outgoing calls, and a total of 70% commercial communication calls, compared to 30% of calls for social communication. The participant communicates with the arothdars from other markets. There was also a communication for transportation and social communication with friends and family members.



Social Network Analysis (SNA)

The participant has close-tie social and commercial contacts. The participant has more social contacts than commercial contracts. However, the participant has more dyad contacts in the phone compare to non-dyad. The participant believes the mobile phone allows him to be able to have more communication with the social and commercial contacts, which also allows him to become more personal with the contacts whether it is a social or commercial relationship.
The participant's social contacts are mostly the friends and family who share social interests with the participant. On the other hand, there are also commercial contacts with whom the participant has close-tie relations with; the buyers of the produce and suppliers of inputs. The contacts therefore do not have a wide range of different types of nodes.

SNA Map



Based on the SNA MAP, the participant has dyadic social contacts with friends, family and extended family. According to the participant, there are some social contacts whom the participant discusses social and commercial aspects, such as the local friend,

brother-in-law and some cousins who are in involved in the same trade. These networks are dyadic and multiplex because of the nature of the communication. There are other social contacts that are not in a similar profession and very close to the contact mainly from a social connectivity perspective, these are dyadic but not multiplex, as the participant does not share commercial discussion with individuals.

Agency

The participant created a number of social and commercial close-tie contacts. The participant believes that these connections are essential for the trade and social life. Based on the social network of the participant, he keeps a very close-tie relationship with a select group of social and commercial contacts. According to the participant, the mobile phone allows him to become visible to these selected groups of people. Regardless of being social or commercial, the relationships are more important from a communication perspective. This priority on the relationship is the motive that drives the participant to maintain regular contact with his social and commercial contacts.

Structure

The participant regularly communicates with the government extension agent and commercial contacts for trade. The social network of the participant shows that the participant prefers to communicate with a set number of people on a regular basis for any trade-related information. These government extension agent and local trader contacts create the structure for the participant to receive information. Along with the commercial contacts, there are social contacts that the individual communicates with frequently that creates a peer group for the participant.
Choice

According to the participant, the mobile phone is vital for his trade, as there are contacts that live beyond the commutable distance for the participant, and the mobile phone is the only means to communicate. The participant's belief that there is no alternative to communicate with the important commercial contacts who are located at distant places is the existence of choice for the participant. The participant's confidence in the mobile phone-based communication is the sense of choice. The participant receiving information and utilizing the knowledge is the use of choice for the participant.
Costs associated with the mobile phone and the financial benefits

The participant spent 1,000 taka (GBP 8-9) on the mobile phone every two to three years. On average, the participant spent 200 taka (GBP 1.8) per month on the mobile phone. According to the participant, the mobile phone has an indirect effect on trade.

Therefore, commercial or financial benefit is difficult to measure. Although there is communication with the commercial contacts, quantifying the benefit in financial terms is difficult.

Case Study Eight

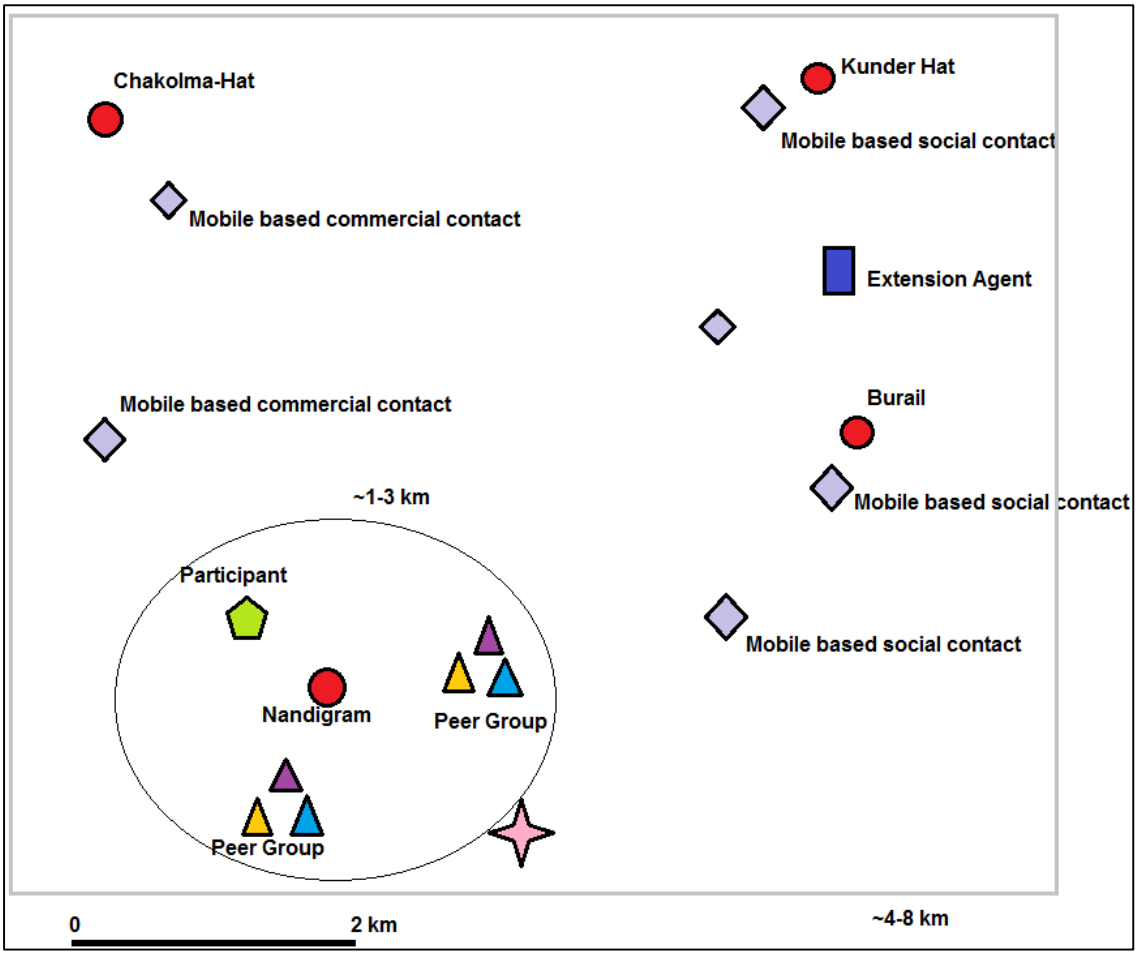
Name: Mr. Siraj
Location: Nandigram hat, Nandigram
Age: 43
Education: Level 5

Background

Mr. Siraj lives within two kilometres of Nandogram hat. The participant has been living in the location since birth; he lives with his parents, wife and two children. The participant owns 2.5 acre of land, where he grows rice in three seasons (Aush, Aman and Boro). The participant has been using the mobile phone since 2007.

Network mobility MAP

For the eighth participant most of his family and friends live within a distance of one to three kilometers. He has family members and commercial contacts in the Chakolma-Hat (approximately eight to nine kilometers). The participant also has major buyers in the Kunder-Hat which is nearly seven to eight kilometres from the participant. The participant also has his commercial contact near Burali, which is nearly four to five kilometers from the participant.



Nature of Network

The eighth participant has a total of eighty-three numbers on his mobile phone. Among the contacts, there are fifty-eight social contacts and fifteen commercial contacts. Among the social contacts, there are his siblings, cousins, friends and neighbours. Among the commercial contacts, there are buyers, seed suppliers, support workers and transporters.

Communication with social and commercial contacts

The participant has a total of eighty-three numbers in his mobile phone. Among the contacts, there are fifty-eight social contacts and fifteen commercial contacts. Among the social contacts, there are his siblings, cousins, friends and neighbours. Among the commercial contacts, there are buyers, seed suppliers, support workers and transporters.

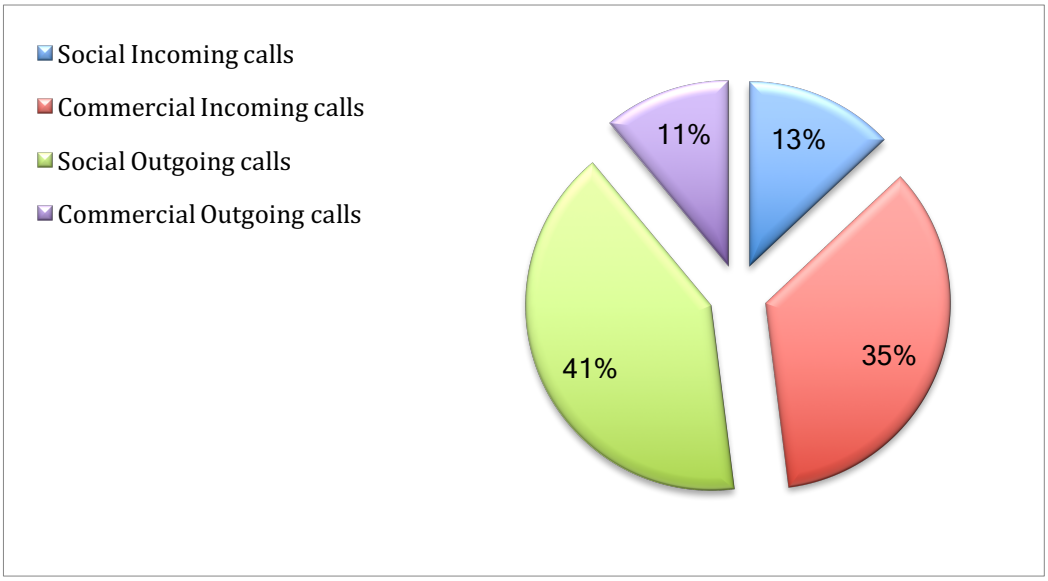
Network and Communication

The participant believes that the mobile phone is useful but not vital for his social and commercial communication. According to the participant, it is useful because it allows the participant to be able to communicate with family members, friends and extended family members. The participant also believes that communication with the commercial contacts becomes much easier with mobile phone. However, the reason he does not consider it very useful is because the farming profession generally involves people not from very distant places, since the buyers or the suppliers are from the nearby market.

> "Mobile is useful but not essential, because most of the time the commercial contacts are local buyers or suppliers who are easily accessible within commutable distance."
>
> - Siraj

According to the participant, he uses the mobile phone an average of one to two times in a week. For the participant the use of mobile phone in different phases(land preparation, lean and harvesting,) does not vary. For comparison, the mobile phone data for the lean period (June 2013) and the harvesting period has been collected. During the lean period, the participant has a total of sixty-one outgoing calls and forty-eight incoming calls. Within the outgoing calls, there were forty-one social calls and eleven commercial calls. Within the incoming calls, there were thirty-five social calls and thirteen commercial calls.

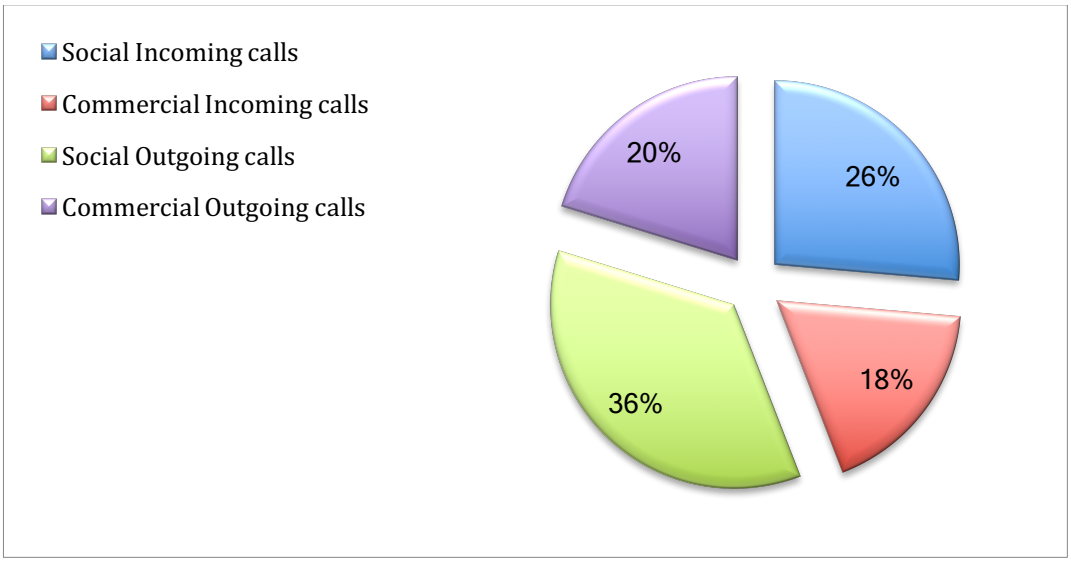
Mobile-based communication during the lean season



There was a total of 76% of calls for social communication (incoming and outgoing calls), compared to 24% of calls for commercial communication during the period. According to the participant, social communication is always the main purpose of the using the mobile phone, as it allows the participant to be able to communicate with his immediate and extended family more frequently. There are also two brothers, a brother-in law and cousin who are involved in the same profession. Therefore, with these contacts, there is social communication along with discussions about farming when needed.

During the harvesting period (July 2013), the participant had a total of ninety-one outgoing calls and seventy-two incoming calls. Among the outgoing calls, there were fifty-eight social calls and thirty-three commercial calls. Among the incoming calls, there were a total of forty-three social calls and twenty-nine commercial calls.

Mobile-based communication during harvesting season

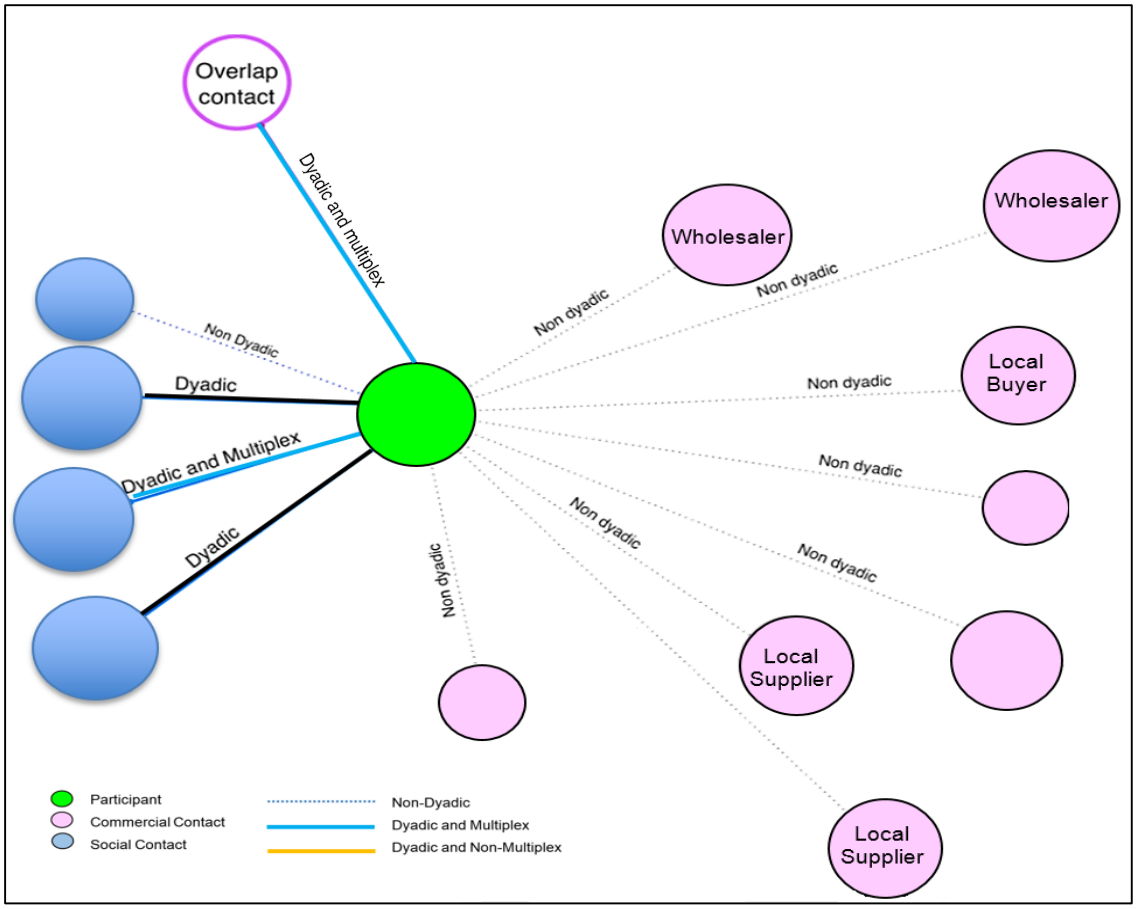


There was a total of 62% calls for social communication, compared to 38% of calls for commercial communication during the harvesting time. The participant mentioned that the overall calls increase because the season requires communication with the buyers, transporters and the workers to help in the field. There is also support required from the family and extended family during this time, which also increases the social communication during harvesting time.

Social Network Analysis (SNA)

The participant has close-tie social contacts. These contacts are the family members, extended family members, friends and siblings. The contact has commercial contacts with whom he exchanges commercial communication, however, this communication with the commercial contacts are used for the business alone.

SNA Map



Based on the SNA MAP, it is evident that the participant has several close-tie social contacts. Within these contacts, there are dyadic and multiplex relationships with whom the participant exchanges both social and commercial communication. On the commercial aspects, there are non-dyadic relations with whom the participant communicates on a commercial needs basis. According to the participant, the commercial contacts are relevant only for commercial purposes and therefore the relationship with these groups of people is confined to business only.

Agency

The participant believes that the use of the mobile phone is beneficial for communicating with the existing contacts more frequently. The participant also believes that the mobile phone is not adding to the relationship. This belief dictates the relationship that has been created by using the mobile phone. The participant, as seen in his social network, has a communication pattern with rather strong social ties but no strong commercial ties. Therefore, the use of the mobile phone has reflected the beliefs of the participant.
Structure - government agencies, groups formed by the buyers or sellers, peer-group

The participant has both social and commercial contacts. However, the participant has strong social contacts. There are family members, extended family members and friends on the contact list that the participant frequently communicates with. There is a presence of a strong family institution or social structure in place for the participant. This social setting dictated how the participant utilized the mobile telephony. There are commercial contacts within the participant's contact list that the participant has a commercial relationship with. These relations were sustained for longer periods. Therefore, the commercial contacts also created a structure for the participant to operate in by keeping the contacts to a minimum number.
Choice

The participant uses the mobile phone to communicate with the family members. The participant chooses the device to communicate with the existing social network. According the participant, the mobile phone is not adding anything different to the social exchange, but it is a means to communicate more frequently. Therefore, the participant using the mobile phone and believing that it is another media of communication is his sense of choice. The participant using the mobile phone to communicate with the social and commercial contacts is the existence of choice for the participant. Although the participant does not find the use of the mobile phone commercially beneficial, from the mobile phone data it is evident that there is communication with the commercial contacts during the harvesting season and lean season. The information that the participant receives from the commercial contacts using the mobile phone and utilizing the knowledge is the use of choice for the participant.

Costs associated with the mobile phone and the financial benefits

The participant spent nearly 1000-1500 taka (GBP 10-13) on the mobile phone every year. The participant also spent an average of 300 Taka (GBP 2.5-2.6) per month on the mobile bill. According the participant, the mobile phone is rather expensive for

the individual because of the frequent communication with family and extended family. The participant believes that there is no financial gain from the mobile phone, but receiving timely information is beneficial in order to stop further losses at times. According to the participant, in the previous year, the participant's land was filled with excess water due to heavy rain in the Aman season. The participant needed advice and support from the family members in order to create the drainage for the field. All communication was done primarily using the mobile phone because rain prevented communication with the extension agent and family members. On that occasion, the mobile phone was instrumental in providing the solution on time. Therefore, there was an indirect financial benefit from the use of the mobile phone.

Case Study Nine

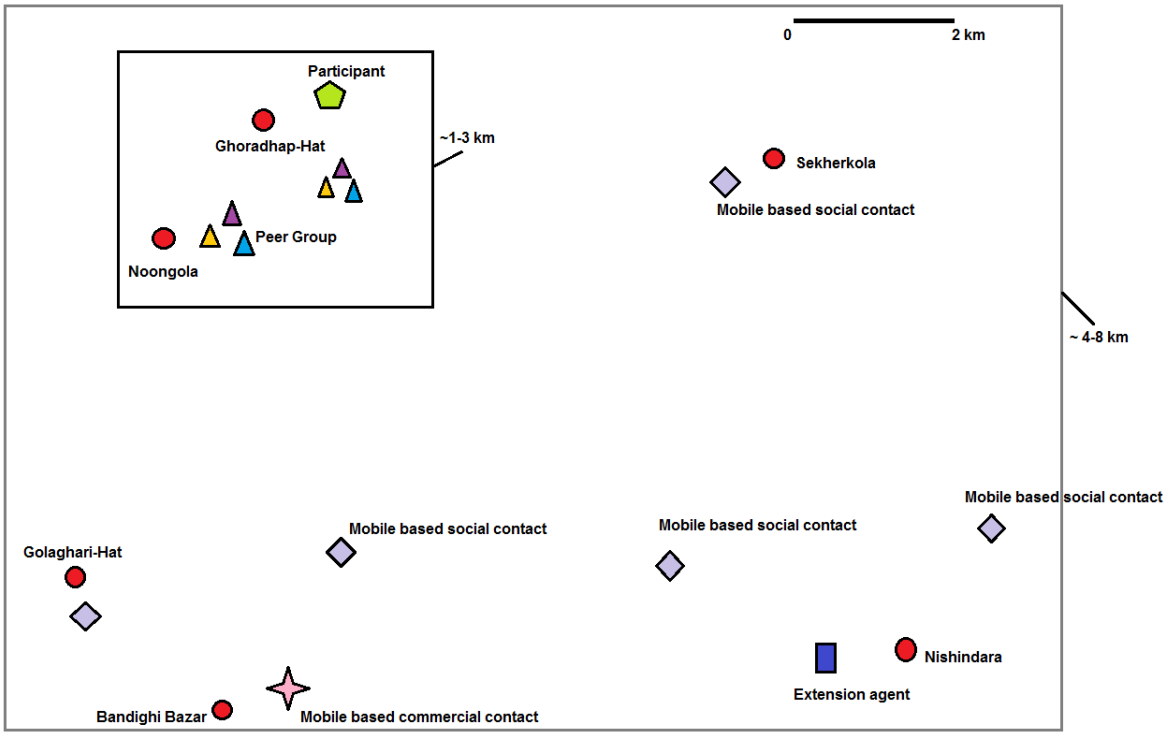
Name: *Mr. Johur*
Location: Ghoradap hat, Noongola
Age: *38*
Education: Level *7*

Background

Mr. Johur lives within one to three kilometres of Noongola. The participant has been living in the village since birth. The participant lives in the village with his wife and two children. The participant owns 1.2 acres of land. The land allows him to grow rice in three seasons (Aush, Aman and Boro).The participant has been using the mobile phone since 2005.

Network mobility map

The ninth participant's family and friends live with three kilometres of the Noongola area. The principal buyer of his produce is an Arothdar from Sekherkola Area, which is approximately seven to eight kilometers from the participant. There is also Aman produce buyer from the Mohish Batah Bazaar (five kilometers). The participant also communicates with a supplier from Nishindara village market, which is eight kilometers from the participant. The participant also occasionally uses a buyer from Gholagari Hat, which is nearly five kilometers from the participant.



Nature of Network

The ninth participant has a total of eighty-six numbers on his mobile phone. Among these numbers, there are fifty-nine commercial contacts and twenty-six social contacts. Among the commercial contacts, there are local buyers, suppliers from the nearest market and distant markers. There are contacts, which was referred by commercial contacts as the best suppliers and buyers. Among the social contacts there is the elder son, siblings, cousins and friends.

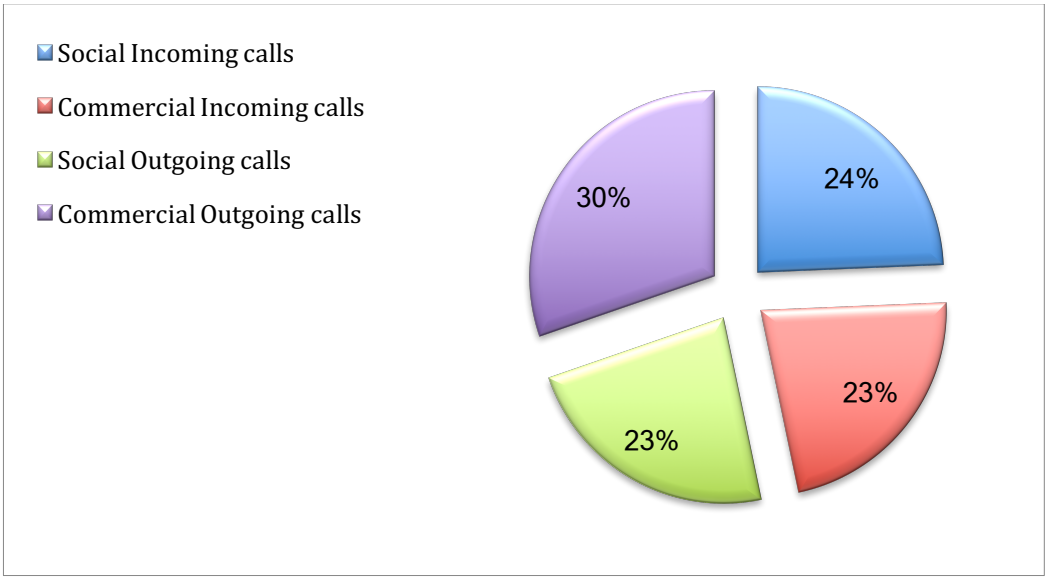
Communication with social and commercial contacts

The participant has a total of eighty-six numbers on his mobile phone. Among these numbers, there are fifty-nine commercial contacts and twenty-six social contacts. Among the commercial contacts there are local buyers and suppliers from the nearest markets and distant markets. There are contacts that were referred by commercial contacts that are considered the best suppliers and buyers. Among the social contacts, there are siblings, cousins, the elder son and friends.

Network and Communication

The participant believes that the mobile phone is very useful for rice production. According to the participant, the family, friends and extended family live nearby, so it is not particularly beneficial from a social communication perspective. However, the participant finds that using the mobile phone for a commercial network is very useful because it allows the participant to talk with commercial contacts in time for the harvesting period so that produce prices can be negotiated. The participant also has the benefit of communicating with the seed and fertilizer wholesalers in the town, which gives him a price competitive advantage. The participant also communicates with the extension agent in times of emergency by using the mobile phone.
According to the participant, he uses a mobile phone an average of three to four times in a week. The participant mentioned that the number increases to four to five during the harvesting season and is reduced to two to three times during the lean period. The mobile data has been collected for the period of the lean season (June 2013) and the harvesting season (July 2014). During the lean season, the participant received a total of seventy-three incoming calls and eighty-two outgoing calls. Among the incoming calls, there were thirty-four commercial calls and thirty-seven social calls. Among the outgoing calls, there were a total of forty-six commercial calls and thirty-five social calls.

Mobile-based communication during lean season

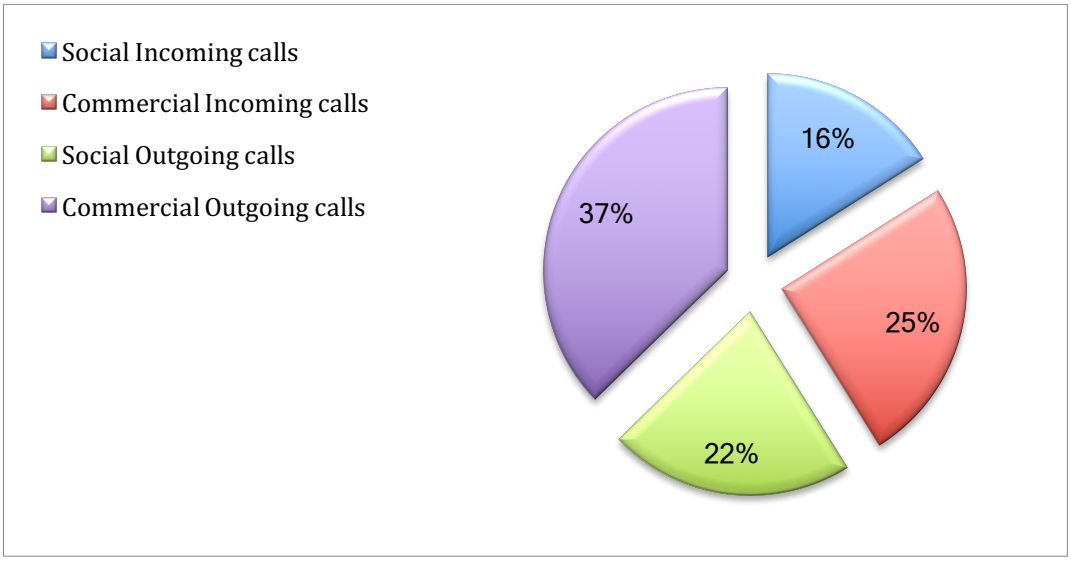


There were a total of 47% of calls for social communication, compared to 53% of calls for commercial communication. According to the participant, even in the lean season, there is lots of communication with commercial contacts such as extension agents and distant suppliers. The participant also believes that the communication with the other

farmers regarding their produce benefits the participant by learning about new farming technologies.

During the harvesting season, the participant received a total of ninety-five incoming calls and one hundred-thirty five outgoing calls. Among the incoming calls, there were a total of fifty-eight commercial calls and thirty-seven social calls. Within the outgoing calls, there were a total of eighty-six commercial calls and fifty social calls.

Mobile-based communication during harvesting season

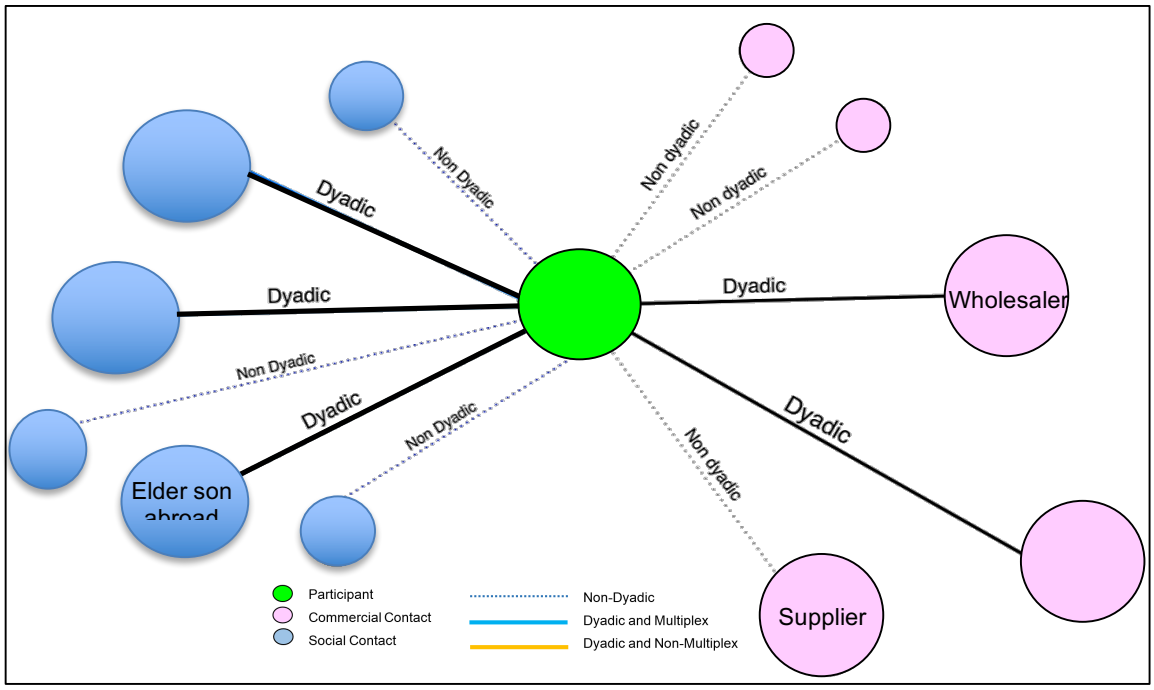


There were 62% of calls for commercial communication, compared to 38% of social calls during the harvesting period. According to the participant, the communication with the commercial contacts increased during the harvesting period because of the communication with the buyers from different markets and gathering the price of the produce during this phase. There is also communication with the transporter and local market farias to negotiate the price of the produce.

Social Network Analysis (SNA)

The participant has close-tie social, commercial contacts. The close-tie social contacts include the extended family and friends. There are commercial contacts that are close to the participant.

SNA Map



Based on the SNA MAP, the participant has dyadic social contacts with family friends, with whom the participant talks frequently. There are also commercial contacts with whom the participant frequently communicates. However, the participant keeps distinct relationships with the social and commercial contacts. Based on their pattern of exchange, it is evident that the participant does not discuss business with social contacts and vice-versa. Therefore, there is no multiplexity of relationship in the network, but dyadic relationship with both social and commercial contact.

Agency

The participant uses the mobile phone to communicate with commercial and social contacts. The participant believes that the mobile phone allows the as individual to be able to communicate to the external world based on his needs. This belief led the participant to create strong-tie commercial contacts. The participant also believes in the purpose of the network. As shown in the social network section, the participant does not have any network multiplexity with his commercial contacts; this indicates that the participant's strong commitment to his nature of contacts created both socially and commercially. The participant also keeps a similar type of social network where the contacts have no common commercial interest. There is also no overlap in the participant's contact list. According to the participant, there are family members who are in a similar profession, but the participant prefers to keep the commercial discussion away from the family.

Structure

The participant contacts government agencies and communicates with buyers and suppliers from a distant market through the mobile phone, which allows the participant to communicate with more traders. The relationship pattern shows a strong tie contact with the commercial contacts. Through these strong-tie commercial contacts, the participant created a strong commercial support structure. The participant also has dyadic social contacts that are the strong social peer groups.
Choice

The participant finds that the use of the mobile phone is beneficial. Communication during the lean season and harvesting season shows that the participant prefers to utilize the mobile phone to regularly communicate with the commercial contacts. According to the participant, the mobile phone is instrumental in keeping the regular contacts with the commercial contacts. The participant's belief of being able to communicate with the commercial contact when needed is the existence of choice. The participant's belief that the mobile phone allows him to able to communicate with more people than before is the sense of choice for the participant. The participant utilizes mobile telephony to conduct commercial negotiation, and this utilization of the mobile phone is the use of choice.

Costs associated with the mobile phone and the financial benefits

The participant spent taka 800-900 (GBP 7-8) every three years for mobile phone. On average, the participant spent 200 (GBP 1.5-2) per month on the mobile bill. According to the participant, the mobile phone has several financial benefits. These benefits involve the money saved for not traveling to the traders from the other markets. The participant's major traders who live in the shekher kola or mohish bazzar require at least 20-30 taka (GBP 2) to visit by commuting on public transport. This fare is saved by making phone calls that cost around 10 taka (GBP .9) for the participant. The participant also has to travel a similar distance for a major supplier. So, from an input supply and information perspective, there are savings by using the mobile phone. From a trade perspective, the participant does not sell the produce to the same buyer every time. According to the participant, the mobile phone is the only device that allows him to communicate with the distant market to negotiate prices. Therefore, there is a distinct financial gain from using the mobile phone. According to the participant, in the last season, the boro rice had a bumper production, which led the market price to drop in the local bazaar. The participant communicated with a city trader using the mobile phone and gained approximately 10 taka (GBP. 8) per kilo on that occasion.

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